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# ECONOMIC ASPECTS OF MARINE PROTECTED AREAS (MPAs)

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# Economic aspects of Marine Protected Areas (MPAs)

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# Summary

Marine Protected Areas are subject to conflicting uses. As such, decision making analysis with respect to their management should be made on a sound base. This book was devoted to introduce the reader to the concept of economics, how it is implemented to natural resources management and especially how it could be applied to MPAs.

The important lessons that can be learned are summarized in the following points:

1. Economic decision making is based on the notion of efficiency. The efficiency criteria depend on the costs and benefits of different alternatives. However, in most natural resources and environmental management cases, and MPAs in our case, there is a problem of achieving efficiency by letting the market operate on its own. This is called market failure. The fact the markets fail to achieve efficiency means that the government should step in and make its decisions based on its own analysis. This is called Cost Benefit Analysis (CBA).

2. We learned that there are different types of market failures in MPAs: Externalities (negative and positive), public good provision and Common Property characteristic.

3. Common Property resources result in over exploitation of fisheries efforts and some times may lead to extinction. We pointed out this issue in a separate chapter in order for the reader to pay attention to this specific problem. It is different from other problems MPAs management deals with. Its main goal is to regulate a commercial activity where the failure of not regulating result from a cross effect of one user (fisherman) on the other. One of the important goals of MPA criteria is to do just that: regulate fishing efforts in the open Sea.

4. Different market failures result in the wrong signaling of development vs. preservation. We saw that while in most cases there is no market value to MPAs, still there is a social value that should be taken into account in the decision making process. We pointed out two important tools with which these values could be captured: The Travel Cost Method (TCM) and The Contingent Valuation Method (CVM). These two concepts have their pros and cons. The first one deals with actual behavior but can capture only the use value component of the site. CVM, on the other hand, can capture both use as well as non use values but relies on hypothetical surveys that sometimes may lead to manipulation in the answering process.

5. We explained how to use these benefit estimation techniques in the CBA process. Besides valuing those benefits, CBA has other points that decision making analysis should deal with. Those include benefits and costs realized at different points in time, risk and uncertainty considerations and equality criteria.

6. We devoted an entire chapter to the financial importance of managing a viable and sustainable MPA. Almost never has an MPA the privilege of being financed by the government. Usually it has to rely on its own sources of revenue generation. May this be justified or not, it is a fact. To deal with that fact, a sound management tool is building a management plan and financial plan for any proposed MPA.

In this book, we tried to raise questions rather than answering them. It is our hope that the readers can find the questions interesting and find the relevant answers in the references we have provided and in implementing the tools suggested to their own case study. Exercising the method suggested in the book might benefit the decision-making process of managing these important assets of the Oceans we all depend on as a society.

# Table of contents

# 1. Introduction

## 1.1. The Mediterranean Sea

The Mediterranean is the cradle of Western civilization, the source of art and science, history and culture, philosophy and democracy of the western world. The Mediterranean has been the source of power and growth of various civilizations for thousands of years. The Mediterranean has always been a source of food and transport and was used as a bridge between cultural centres that have changed places along its shores for centuries.

Figure 1.1. Mediterranean Basin

The Mediterranean is an inter-continent sea, closed between Asia, Africa and Europe and is covering an area of 2.5 million km2. It stretches to about 3,800 km from east to west and is about 1,800 km wide. The average depth of the Mediterranean is 1,500 meters, and its maximal depth is 5,150 meters (south of Crete). The Mediterranean is connected to the Atlantic Ocean by the Gibraltar straits on its western side, to the Black Sea by the Dardanelle straits on its eastern side and to the Red Sea by the Suez Canal on its south eastern side. This unique geography of a closed sea, results in low waves and turbulence, making the sea more susceptible to the accumulation of pollutants (Figure 1.1).

There are about 145 million inhabitants along the 46,000 km shore-line of the Mediterranean. This number is almost doubled during the summer season by an addition of about 130 million tourists who come on vacation during July-September.

The Mediterranean composes of about 1% of the world area of seas and oceans and yet about 30% of the world transport by sea is going through its waters.

Although characterized with a certain climate, vegetation, building style and agricultural products, the 22 states surrounding the Mediterranean shores are diversified culturally, religiously

and politically. Most of the states are part of the European community, some are part of the Islamic world and some belong to neither.

In spite of this variety, all the countries around the Mediterranean share the same problem of polluting and destructing its shores and waters. In spite of the remarkable heterogeneity of nations, they all acknowledged the need for a comprehensive approach in trying to manage the Mediterranean shores.

The highly populated shores of the Mediterranean basin cause sever environmental pressure on ecosystems of the marine environment. The shores and the human activity associated with them need to be managed properly in order to enable us to further enjoy the beaches, the historical sites, the agricultural and cultural assets and the unique resorts of the area which is considered to be the Cradle of Civilization.

The negative influence of man on the Mediterranean marine environment comes from various sources: destruction of sandy beaches by exploiting the sand as a building material and by digging and enlarging sea-ports; loss of open spaces by intensive building and enlarging of tourist resorts; polluting the water with sewage and solid wastes from industrial, agricultural, municipal and military land sources; polluting the water from marine sources (like ships, tankers); over fishing that degrades the food chain and creates  an unbalanced marine ecosystem and air-pollution.

In 1978, the Mediterranean states signed the **Barcelona Convention** in order to protect the Mediterranean from pollution. This convention is the legal frame-work for the implementation of the **Mediterranean Action Plan** (MAP). The Barcelona convention was meant to be a tool that will enable the Mediterranean nations to monitor the situation of the sea, to identify environmental problems and their sources. The convention calls for the Mediterranean nations to take every necessary means to minimise sea pollution and protect its marine environment.

Another important treaty is the MARPOL, an international Convention for the Prevention of Pollution from Ships. The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years.

## 1.2. What are MPAs?

The purpose of declaring a protected area is, as its name suggests, protecting a specified region from certain human impacts. That is, to maintain its natural characteristics. There are several factors that protected areas should be protecting from. Most are associated with some form of exploitation (such as fisheries, harvesting) or some form of commercial development (roads, housing, shopping malls).

MPAs are protected areas in the Ocean or adjacent beaches which are regulated more rigidly than elsewhere. This is done especially to achieve some conservation goals such as to protect living organisms and their habitat. Another goal is to regulate some commercial activity such as fishery harvest that would be managed inefficiently under a free accesses management. The regulation can range from "no-take" areas, in which no form of activity is allowed to "zoned" areas, in which only some uses are permitted to some extent.

On one hand MPAs can be used for fishery management such as restricting fishing efforts on fish stock or protecting an area where certain fish population spawn. On the other hand, MPAs often involve more than just fishery management. They deal with an integrated ocean management which includes conservation goals as well. This creates a richer set of issues to address in management analysis.

In planning a comprehensive policy and management plan, here are the major costs and benefits to be considered (adapted from Cesar, 2000):

**Costs:**

*Opportunity Costs (loss of potential earnings):*

- Short-term fishery revenues
- Revenues from activities forbidden in the MPA, such as coral mining, shell extraction and blast fishing
- Large-scale tourism and resort development
- Industrial and infrastructure development

*Direct Costs:*

- Establishment costs
- Administration costs
- Employment costs
- Monitoring and enforcement costs

*Indirect costs* (possible compensation payments to those adversely affected by the decision to establish the reserve):

- Fishers and processors in the short-term
- Alternative employment packages
- Infrastructure costs of increasing tourism
- Displaced communities, if relocated

**Benefits:**

*Fishery Enhancement:*

- After some time lags, the results of protection include larger, more valuable and variable fish species within the reserve, with transfer of benefits to fishing areas through adult spillover and larval export.
- Habitat protection increases production in reserves.
- Stock protection reduces the likelihood of fishery collapse



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

*Tourism & Recreation:*

- Better opportunities for tourism and recreation are a major objective of many protected areas.
- Enhancement of fish stocks in reserves and the associated habitat protection increase appeal for tourism. This creates employment opportunities directly linked to the reserve (e.g. tour guides, wardens) and could stimulate a multiplier effect through the local economy (e.g. hotels, restaurants, infrastructure, taxi services, etc.).

*Biodiversity Conservation:*

- Reserve protection leads to the recovery of exploited species in reserves, increased species diversity and improvements in habitat. These changes are expected to lead to greater resilience of populations to environmental perturbations, reducing the likelihood of local extinctions.

*Ecosystem Services:*

- Other than fishing, protection of reefs provides protection against storms and coastal erosion, and increases assimilative capacity for pollutants.

*Biochemical Informational Services:*

- There are potential gains from pharmaceutical bioprospecting - future discoveries of important medicinal components

*Education and Research:*

- Reserves provide opportunities to learn about processes from 'undisturbed' regions.

## 1.3. MPAs in the Mediterranean

### 1.3.1. Threats to Ecosystems and Species Diversity

The coastal marine area of the Mediterranean shelters rich ecosystems and a few areas of high productivity in the sea. Among the ecosystems that occupy coastal marine areas, the rocky intertidals, estuaries, and, above all, sea-grass meadows (mainly Posidonia oceanica) are of significant ecological value. These and other ecosystems are also important for endangered species. This is the case for the Mediterranean monk seal, which uses caves as habitat, for marine turtles, which use sandy beaches for nesting, sea-grasses for feeding and sea-grasses or muddy bottoms for wintering, and for marine birds, which use wetlands, rocky shores or islands for nesting and resting (Sala 2004).

Coastal marine ecosystems in the Mediterranean are endangered by the intense development of various activities in the region, including those linked with urbanization and rapid population increases. These activities include the discharge of untreated sewage, discharge of industrial wastes in rivers and at sea, construction of roads, airports and marinas, dredging of sand and gravel, and anchoring of a large number of pleasure boats that swarm along the coast in summer.

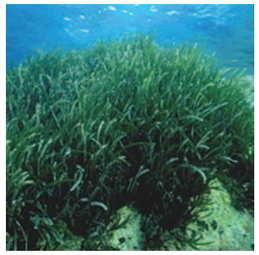


**Figure 1.2: *Posidonia oceanica*** (http://www.portcrosparcnational.fr/patrimoine/images/fiche_flore_marine_posidonie.jpg)

*Posidonia oceanica*, a Mediterranean endemic species, is one of the best-known as well as most endangered plants in the Mediterranean Sea. It is not an alga but a flowering plant, i.e. a vascular plant with all the characteristic Uody parts - rhizome and roots, leaves, flowers and fruits. At first sight it reminds us of grasses; this is the reason why we usually refer to it as to a grass. *Posidonia oceanica* is the largest sea-grass in the Adriatic Sea. Its name - given after Poseidon, the chief god of the sea - seems very appropriate indeed, for its extensive underwater meadows that spread from the shore to the depth of 40 meters represent one of the key ecosystems of the Mediterranean Sea. http://dragonja.nib.si/Zusterna/

Let's take a look at some of the typical and threatened ecosystems of the Mediterranean (Batisse and Grissac 1995). Sea-grass meadows are important habitat for numerous marine species (in particular fish, crustaceans and marine turtles) for breeding, feeding and resting. There is a direct link between the presence of sea-grass and fish production, and together with wetlands, sea-grass meadows produce more than 80 percent of the annual fish yield in the Mediterranean. Yet sea-grass is endangered by all the impacts of human pressure on the seashore. Posidonia oceanica meadows constitute the most characteristic and the most important Mediterranean marine ecosystem and are the most important fish production areas in the Mediterranean (Figure 1.2). They play a central role in stabilizing the seashore and in maintaining water quality, particularly through oxygen production. The stability of the seashore is maintained by this "submarine forest," which holds sediment between its roots, reducing currents and swell. Its vertical growth thus acts as a submerged breakwater, and the destruction of sea-grass can have immediate and irreversible effects on the position of the shoreline. In a number of places the disappearance of sandy beaches has soon followed the disappearance of sea-grass meadows. The sustainability of important fisheries (fish and shrimps in particular) is directly connected with the presence of sea-grasses.

Another type of endangered ecosystem is the Mediterranean wetlands and lagoons, which are of great significance to the conservation of biological diversity and are also highly productive. They perform numerous other functions related to flood control, recreation, tourism, fisheries and agriculture as well as chemical and physical reduction of pollution. They also act as breeding and wintering areas for a great variety of birds and are essential stopover points on the migratory routes of numerous bird species.

Wetlands and lagoons are facing direct threats, such as reclamation for industrial development, infrastructure, agriculture and tourism and indirect threats such as the diversion of rivers and pumping from underground aquifers.

Estuaries constitute another important habitat since there are some 70 sizeable rivers and streams flowing into the Mediterranean. They are dominated by the deposition of sediments and, in most cases, by a fairly high level of industrial and agricultural pollution. A number of large or medium size cities are located close to estuaries.

Many Mediterranean species are endemic (20 percent) therefore their protection is crucial (Ketchum 1983). Some of these species, which represent various groups, are at risk either by over exploitation or by pollution and lost of habitat. We will examine a few:

**Invertebrates** such as mollusks support some of the more valuable fisheries. Mechanized clam ("vongole") harvesting in the Adriatic used to be a valuable fishery, but suffered from overexploitation in the 1980s and probably also from the effects of pollution. Some mollusks that are endemic to the Mediterranean are endangered due to over collection and habitat destruction.

*Sponges* constitute a traditional resource of the Mediterranean. They have also suffered from heavy collecting, particularly in the Eastern Basin; stronger collecting regulations are called for.

*Red coral (Corallium rubrum)* is a valuable resource in the Mediterranean, being used for the production of jewelry. There is increasing concern about the declining returns to an increasingly sophisticated harvest sector, which has exchanged primitive dragging equipment for diving equipment capable of operating at depths of 100 meters. A rotating harvest scheme was seen by the industry and scientists as one of the few realistic options for this heavily exploited resources. In the absence of more effective control, this species is likely to be placed on the CITES list of species for which export of the organism or its products is restricted or prohibited.

There are three species of endangered marine turtle in the Mediterranean - the loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), and green turtle (*Chelonia mydas*). While the loggerhead remains relatively abundant, it seems to have deserted many parts of the Western Basin where it is disturbed by fishing activity. The other two species are becoming increasingly rare. There are only a total of 2,000 nesting females at the nesting sites which are located in the Eastern basin, and this number is declining rapidly. The leatherback turtle is rarely seen in the Mediterranean, although there are some breeding records for Israel and Sicily.

Several species of marine mammals have reached dangerously low population levels, and their survival has become questionable unless immediate measures are taken for their conservation. The species in which this is most evident is *Monachus monachus* (Mediterranean monk seal), which depends on rocky islands and archipelagoes free from disturbance as breeding sites. The population of these seals in the Mediterranean is probably less than 300 individuals. Hence, we can see that increasing coastal populations, expanding tourism activities and other developments are placing ever increasing pressure on the marine environment. The major affecting factors are both from the mainland such as high levels of industrial and agricultural pollution, discharge of untreated sewage and industrial wastes, reclamation of land for developing plans, dredging of sand and gravel, and form action at sea such as disturbance at breeding sites, heavy collecting and overexploitation of marine species.

All of these issues can be addressed and mitigated by forming a comprehensive network of MPAs to ensure the protection of endangered and threatened endemic species and habitats of the Mediterranean.

In the following chapters of this book we will try to show how environmental economics can help solve some of these pressing issues.



## 1.4. Relevance of Economic Analysis to MPAs Management

Economics deals with choice between alternatives. In the case of MPAs, there are two sets of choices or questions: 1) should we construct MPAs? 2) What would be the most suitable way of constructing, managing, operating and financing them?

One research direction deals with the ecological aspects of MPAs. It deals mainly with the benefits created by establishing an MPAs. Yet the other direction deals with the process itself by which an MPA is developed and implemented and the policy and economic issues associated with it. It is the latter which is in the heart of this book. One major distinction between these two research directions is that the first one deals with the benefit of MPAs while the second one takes it one step ahead to deal with opposition to MPAs.

The need to deal with opposition to MPAs raises an important question as to why there would be any opposition if MPAs produce only benefits. The answer is that, as in any other human activity, implementation of MPAs produces not only benefits but also costs. The problem of benefits and costs gets more difficult because they do not appear uniformly; some individuals may be net beneficiaries while others may be net losers. Another complication is that benefits and costs usually appear at different points in time.

The importance of addressing MPAs is thus not only collecting information about the technical knowledge and matters. Perhaps, at least as important is the human side dealing with various connections among ocean users, coastal communities, tax payers and conservationists. It is clear from the above discussion that economics (and other social sciences) have a major role in the design, management, and valuation of MPAs. Especially, there is a need to develop a methodology to balance between benefits and costs, multiple uses and goals, and to understand and analyze the dynamics of decision making process. This is the main purpose of this book.

There are different sorts of economic analysis that might take place. They range from traditional profit analysis of commercial activities, through optimization of marine fishery through bioeconomic modeling and up to cost-benefit analysis which includes non-market valuation.

Several important fronts should be emphasized with respect to the economic aspects of MPAs:

- MPAs consist of natural as well as human dimension. Therefore, analysis of MPAs should be interdisciplinary in nature.
- MPAs analysis and research can be both theoretical as well as applied. Theoretical research focus mainly on the insight of the dynamics and performance of MPAs. Applied research starts from a case study and builds up to generalize conclusions and create building a body of MPAs situations that might help later to generalize on the individual case studies.
- MPAs analysis can range from total optimization to simple behavior analysis. In the former, the emphasis is on the best MPA design and management. Usually, addressing factors such as the size and uses in a given MPA. The later deals with specific topics such as interactions of humans with nature under different circumstances.
- MPAs are created, at least in part, as a response to uncertainty. In this regard we might consider an MPA as an insurance policy to maintain a minimal level of ecosystem. Therefore, the

emphasize here is on the importance of uncertainty, both as a natural part of the environment (like changes in weather conditions) and as part of the human activity (like changes in development plans) in the region.

Economics is closely related to MPAs management. It deals with decisions about how to allocate resources for conservation of those unique areas and the more important issue of justifying those conservation efforts. MPAs maintain ample opportunities for households, industry, current and future generation and local and global communities. Economic analysis tries to value those benefits in order to understand better if and how to allocate the resources needed in order to manage them properly.

In order to understand how to better manage MPAs, it is important to understand the factors that play a major role in the degradation of these areas. This can help us understand how to affect decision makers when making their decisions in order to better incorporate conflicting values into their actions.

Unless it can be proved that MPAs do not generate benefits that are at least as high as the costs incurred in carrying them, the management plan which is based on wrong cost-benefit analysis will not be sustainable. But insuring that benefits exceed costs is not sufficient for a successful management scheme. It should also be guaranteed that sufficient finance is available in order to carry out those conservation efforts.

The followings are the major steps that an economic analysis should follow:

1. **Identify the economic benefits in preserving the MPA** - This step is needed in order to understand how an MPA can help economic activities and social values. It is important in order to later compare those benefits to the costs. It is also important in order to understand how to finance the desired activities - by governmental taxes, entrance fees etc.,

   MPAs have a wide range of services they provide. Only part of them can be sold at the market - fish and other commercial goods, for example. But there are other types of benefits that still have an impact on society and they are not reflected in the market because there are no markets for such goods - coastal protection, storm control, carbon sequestration and breeding grounds for habitat for marine fish, birds and mammals are only examples of such services. These services are called in the economic jargons "Non-market goods".

   Still there are even services that are associated with people who will never visit the site, such as the option to visit in the future and the mere existence of the site.

2. **Identify the economic costs associated with preserving the MPA** - This step is important because it helps distinguish between direct (maintaining the area) and indirect (lost development opportunities) costs. This separation is helpful in understanding where objections might arise and also to relate revenues generations to sustainable management of the site.

   Operation and management costs fall under direct costs but land and other resource uses have an alternative potential. Therefore, ignoring those values underestimates the total cost of using the site for any given purpose. For example, preserving the site entails alternative costs of land that could be used for commercial purposes. On the other hand, using the site commercially entails alternative costs of the lost benefits of preservation.

3. **Valuation of Benefits and costs** - This step is important for making a crucial decision about preserving the site on economic ground. The major purpose is to put all benefits and costs on the same footing. Dollars and cents. Since only the parts of the values are expressed in monetary terms through their market value, we should think about ways to express values in monetary terms for the other services.

   There are two main approaches to value those services - through nearby operating markets and through hypothetical ones. The first approach considers substitute markets (nearby) to the missing one. Therefore it is also called an indirect approach, or a revealed preference approach, because the researcher is looking at people's actual behavior regarding the good or the service in question to get its value. Those can include substitute goods (to Corals for example) or fuel and lost time (when deciding to visit a certain MPA). Hypothetical markets use surveys as their way of valuing the goods or services in question. Therefore it is called a direct approach, or a revealed preference approach, since people state their preference regarding the good or service in question. This method is the only one which can be used in order to get form people their value of the site, even though they don't intend to visit it. However, this method is also the most controversial one because it relies on a hypothetical basis.

   Measuring costs can also be done in several alternatives. The most straightforward one is the accounting approach. Just add all those costs that are associated with well known out-of-pocket values. Operation and maintenance costs for example. However, other costs can not be done in such a way. Measuring the cost of coral reef deterioration, beach restoration etc., should be estimated by other means. For example, one way of estimating the cost is by the replacement cost approach. That is, what will it cost to provide the same service by the next available mean?

4. **Distribution of benefits and costs** - This step is important in order to identify gainers and losers. Without that it will be hard to plan a sustainable management strategy in order to compensate the losers and by that to move towards a more equitable distribution of net benefits from an efficient management point of view.

   Government, local authorities, the local business sector and tourists are all part of this analysis. Comparing their current situation the one after the change is an important step. It can reveal who can finance the project and who should be provided a safety network to compensate for possible damage because of the program.

5. **Identify economic incentives to generate revenues** - This step is important because sometimes a good economic analysis is stalled due to lack of a complement program as to how to finance the cost needed to protect the site.

   There are different ways in which incentives can be created. One way is to charge those beneficiaries who do not take into account the full consequences of their actions. Cruise operators, tourists and hotel openers are a few examples of users who take into account



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

the consequences of their actions only upon themselves whereas they actually affect others as well. Taxing them can provide a source of revenue for managing the site. Yet, another option is to privatize the resource. Private property management is more efficient than a public one because the owner bears the entire consequence of his actions. However, privatization cannot deal with the problem of un-priced services but rather with problems of free access. Finally, there are options for raising revenues through fees levied on the users. This can be in the form of entrance fees, concession payment for souvenirs and other goods, franchise with local operators and the like.

## 1.5. Structure of the Book

After the first chapter which you just finished reading, there are five more chapters. The second chapter deals with a simplified introduction to economics, efficiency and market failures. As you will see below, dealing with environmental issues in general and MPAs in particular, needs a special treatment from an economic point of view. It is different from any financial decision making process in that the preferred solution is almost never what the market suggests. In order to understand that, we need to understand the meaning of efficiency and market failures.

Chapter 3 deals with an important market failure that MPAs can deal with: Over exploitation of fisheries efforts. As will be seen below, fishing in the open sea has a big drawback because the property rights on the fishing grounds do not belong to anyone in particular. That lack of rights brings to over exploitation which can sometimes (but not always) lead to extinction.

Chapter 4 deals with Cost Benefit Analysis (CBA). Whenever market failures exist and the market system is not a good mechanism to allocate resources and to make reliable decisions, we use CBA in order to take into account all benefits and costs involved. The theoretical issues as well as how to take into account benefits and costs presented in different points in time, risk and uncertainty and equality issues will be introduced and discussed.

One of the major tasks in dealing with CBA is to deal with the issue of benefit estimation. How do we give a monetary value to clean beaches, endangered species and alike? In order to do that, we introduce in chapter 5 two very important techniques: The Travel Cost Method (TCM) and the Contingent Valuation Method (CVM). We explore the pros and cons of each one and show step by step how to perform an estimation analysis using those methods.

CBA is a social choice of choosing among competing alternatives. However, care should be given to the issue of how to finance environmental projects; in our case, how to finance and use revenues originated from creating MPAs. Should the national government deal with that? Or the local authorities? Should we price those protected areas and what should we do with the revenues? All these issues are dealt with in chapter 6. We also explore the importance of building a solid financial plan which must support every Cost Benefit study.

We present a list of relevant references for each chapter. We also present case studies in two formats: Boxes within the chapter itself and a special subsection which concludes chapters 3, 4, 5 and 6 with respect to representative case studies. Lists of further readings, which are not dealt with in the book, are also added for a deeper exploration of the subject. The interested readers can look at those suggested reading and find their way to more case studies and references cited there. We believe we made a significant effort to cover most of the relevant material on the subject. We hope it can help our readers in dealing with this important issue in order to have an educated decision-making process.

## 1.6. Further readings and additional references

Further readings:

1) Margat Jean and Vallée Domitille Domitille (2000). Mediterranean Vision on water, Population and the environment for the 21st Century. Document prepared by the Blue Plan for the Global Water Partnership/Medtac in the programme of the World Water Vision of the World Water Council. Blue Plan January 2000.

This document tries to answer some of the questions concerning the intensive demographic, social, cultural, economic and environmental changes that Mediterranean countries are undergoing. The document tries to suggest the path to follow in order to shift from unacceptable to desirable development.

2) RAC/SPA - Tunis, September 2002. Status and Knowledge of Marine and Coastal Biodiversity in the Mediterranean Sea.

This document reports a questionnaire that has been distributed to focal-point scientists of almost all countries facing the Mediterranean Sea, covering the three continents (Africa, Asia and Europe) and both the East-West and North-South gradients, in order to evaluate the state of knowledge of Mediterranean biodiversity, considering the three perceptions of biodiversity - genetic, taxonomic and ecological.

3) Task Force on Economic Benefits of Protected Areas of the World Commission on Protected Areas (WCPA) of IUCN, in collaboration with the Economics Service Unit of IUCN (1998). Economic Values of Protected Areas: Guidelines for Protected Area Managers. IUCN, Gland, Switzerland and Cambridge, UK, xii + 52 pp.

A document prepared by the IUCN World Commission on Protected areas in partnership with the Environmental Planning Research Unit, Department of City and Regional Planning, Cardiff University, Wales, UK. The document is intended to give guidelines to all those concerned with the policy and practice of protected areas. There are about 16 case studies analyzed in this document.

4) UNEP/MAP - City / Country 2002. Safeguarding Mediterranean Biodiversity. Regional Activity Centre for Specially Protected Areas (RAC/SPA).

A description of the Mediterranean environment, its biodiversity, ecosystems and developing pressures.

5) UNEP/MAP/MED POL: Transboundary Diagnostic Analysis (TDA) for the Mediterranean Sea, UNEP/MAP, Athens, 2004.

This is a Transboundary Diagnostic Analysis (TDA). Its purpose is to scale the relative importance of sources and causes, both immediate and root, of transboundary waters problems, such as there may be in the Mediterranean basin, and to identify potential preventive and remedial actions. The TDA provides the technical basis for refinement of both the National level and the area of international waters.

Additional references:
Facts about the Mediterranean Sea:
http://www.factbites.com/topics/Mediterranean



# 2. Economics,Efficiency and Market Behavior

## 2.1. Introduction

We shall start with the most basic question, what is economics? The basic definition is: The study of the efficient allocation of resources to maximize the objectives of an individual or a community of individuals.

Economics focuses on the fact that since resources are limited (scarce), people cannot have all the goods and services that they would like to have. As a result, they must choose some things and give up others. These choices about which goods and services are most highly valued dictate how resources are allocated within society.

Some of the critical questions that arise in economics are:

- What do our objectives suggest about how resources should be allocated?
- What sorts of mechanisms or institutions are effective at achieving that allocation?
- What sorts of tradeoffs must be made among different objectives?
- Under what circumstances will the objectives of the individual be compatible with the objectives of the community (and what can you do if they aren't?)

Nobody explicitly wants the planet to turn into a barren, degraded rock falling around the sun, and yet we make decisions every day that many people argue push us in that direction. Why? What are we responding to? What are the institutions available to us, particularly the market and the government, doing to encourage or prevent it?

The Economic Perspective is based on two fundamental precepts:

- The assumption that scarcity requires choice and that all choices entail a cost.
- The assumption that people make rational decisions and make choices based on their own self interest.

## 2.2. Demand and Willingness to Pay

Making an economic decision is essentially a question of comparing the costs and benefits of an alternative that is available to us. The benefits of doing something represent whatever value we will derive from taking that action, and the costs represent what we have to give up if we choose to take that action.

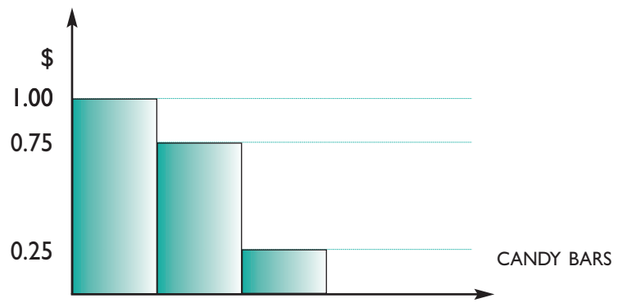
These benefits and costs do not have to be monetary. The benefits of an action could be an increase in a probability of survival for an individual when he or she compares the costs and benefits of standing versus running when in battle. The costs could be his loss of dignity, or self-respect, if he chooses to run when others are fighting. Costs and benefits can be measured in any terms. However, in decision-making, dollars represent a convenient and comparable currency, and that is why we keep coming back to the use of dollars as a measure of benefits and costs.

In order to understand the relationship between benefit and value we have to introduce the notion of **Marginal Benefit (or Marginal Willingness to Pay)**.

The Marginal Willingness to Pay curve illustrates the relationship between the number of units of a good a consumer has and the value (or benefits) that an additional unit would provide to the "consumer".

Marginal Willingness to Pay describes how much a person is willing to pay for an additional unit of a good. For example, figure 2.1 describes the marginal benefit a student has for candy bars. When she had 2 candy bars, the student was willing to pay $.25 for an additional (third) candy bar. That is her marginal willingness to pay for a third candy bar.

Fig. 2.1: Marginal Willingness to Pay






Total Willingness to Pay (TWP): the total amount that a person would be willing to pay to attain a specific consumption level rather than go without the good entirely. This is measured as the area under the marginal willingness to pay (MWTP) curve between consumption=0 and consumption at the specified level. So, as can be seen from the figure above, the TWP for 3 candy bars is $2.

The downward slope of the MWTP curve illustrates one of the central tenets in economics- the notion of diminishing willingness to pay. Diminishing WTP means that as the number of units of a good consumed increase, the willingness to pay for additional units of that good normally goes down.

This same assumption is made for environmental goods such as Marine assets- it means that the more units of environmental quality we have, the less we are willing to pay for an additional unit of environmental quality. Conversely, the fewer units of environmental quality we have, the more we are willing to pay to "improve it" or to develop more units of environmental quality.

The rule of diminishing MWTP means that MWTP curves will ALWAYS slope down.

A demand curve shows the relationship between price and the quantity of a good demanded.

The demand curve is represented by the same line as the **Marginal Willingness to Pay** curve. The demand curve arises because we place a certain amount of value on units of a good, so we are willing to pay that amount for it. It is the relationship between willingness to pay and price that determines how much I would demand if the good was offered to us at a specific price. The demand curve illustrates how many units we would demand if the good was offered at several different prices.

Now, looking at the graph above, if I sell the student her first candy bar for exactly $1.00, is she any better off as a result of that trade?

NO - We are only better off if what we get in trade is worth **more** to us than what we pay for it. In this case, the student received a candy bar that was worth $1.00 to her, in exchange for $1.00. She is exactly as well off as she was before- holding something worth $1.00 to her both before and after the trade.

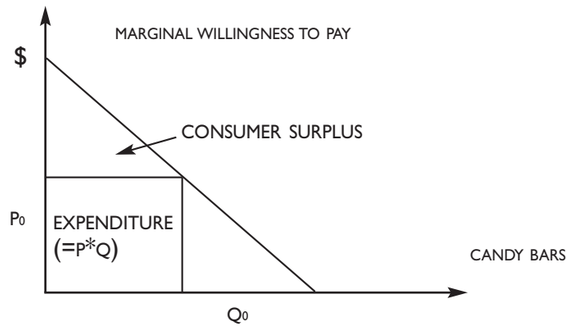
But, suppose we had offered to sell her that first candy bar for $.60. She would buy the first candy bar, of course, and she would receive $1.00 in value from it, but she would only have to pay $.60 for it, so she is better off than before she bought the candy bar. The difference in value ($1.00 - $.60), is called **consumer surplus**. Consumer surplus refers to the difference between what you would be willing to pay for a good (the benefits you expect to receive from it) and what you actually have to pay for the good (or the cost of the good). For that first unit, her consumer surplus was $.40.

If we offered her unlimited candy bars at $.60, she would also choose to purchase a second candy bar, because she would expect to receive $.75 worth of value from that bar, but it would only cost her $.60. Her consumer surplus from purchase of the second bar would be

($.75-$.60) = $ .15 and her consumer surplus from purchase of the first and second bars together would be $.40 + $.15.

Consumer Surplus is equal to the NET benefit received by the consumer for a particular level of consumption: Total Benefit (Total WTP for that level of consumption) - Expenditure (figure 2.2).

Figure 2.2: Consumer Surplus




What about a third candy bar? She would choose NOT to purchase a third candy bar, because given that she already has two bars, her MWTP for the third one (which represents the benefits she expects to receive from it) is only $.25. Since it would cost her more than that to purchase the bar, she chooses NOT to buy it.

### Consumer Surplus

Consumer Surplus is the difference between the amount consumers are willing to pay for a commodity and what they actually have to pay for it (price of the good). The consumer's willingness to pay reflects the benefits they expect to derive from consumption, so consumer surplus is in effect a measure of the difference to the consumer between the benefits and costs of consumption. It is used as a measure of consumer welfare, and any level of consumption is measured as the difference between the consumer's total willingness to pay for that level of consumption and their expenditure (price paid times quantity consumed) on that level of consumption.

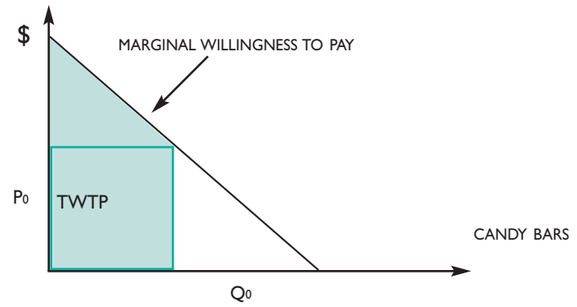




### Total Willingness to Pay

The total amount that an individual or group would be willing to pay to consume X units of a good rather than go without the good entirely. Because willingness to pay reflects the benefits derived from consumption of a good, this quantity also measures the total benefits that individual or group expects to derive from consuming X units of the good. Total willingness to pay is measured as the area under the marginal willingness to pay curve up to a specific level of consumption (figure 2.3).

Figure 2.3: Total Willingness to Pay




## 2.3. Supply and Marginal Cost

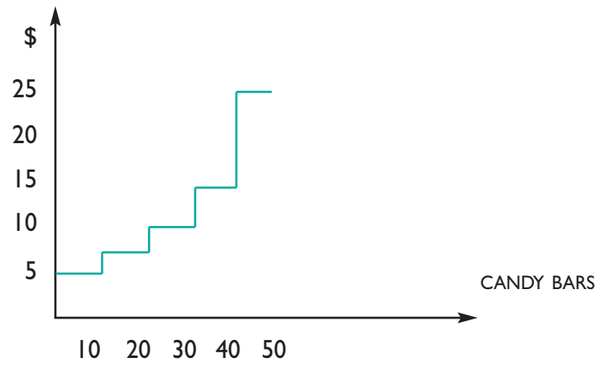
Now we need to look at the production and supply side of the market. Whereas on the consumer side we looked at willingness to pay for goods, or consumer valuation of goods, with supply we are concerned with the costs of providing a good. It is generally true that putting something on the market entails some kind of cost, for the most part; things cannot be created out of thin air. We summarize cost information using cost curves that are very similar in concept to the marginal willingness to pay curves we have already been introduced to. Many of the same concepts that we applied to the willingness to pay curves will be applied to the cost curves.

First of all, suppose that we area paper factory, and we produce notebooks. What does it cost us to produce those notebooks?

Given the cheapest available current technology, we can produce 10,000 notebooks at $ 5.00 each (figure 2.4). If we want to produce any more than 10,000 notebooks, though, we have to invest in some slightly fancier machinery, and hire more people, so we will be able to produce the next 10,000 notebooks at $7.00 each. If we want to increase output even more, then we have to further increase the amount of machinery in our factory, increase our workforce and hire a manager to oversee the process. As a result, the next 10,000 notebooks would be a little bit more expensive- they would be $10.00 each. At that stage, if we want to increase by another 10,000 notebooks, we are going to have to invest in additional factory

space, workers, and machinery and those additional notebooks are going to cost us $15.00 each. Any notebooks produced above that point would cost us an exorbitant $25.00 each.

Figure 2.4: Marginal Cost of Production




What we have here is the marginal cost curve associated with notebook production. What is marginal cost?

Marginal cost (MC) is the additional cost of producing one more unit of a good. So the marginal cost of the 1st unit is how much it cost to go from producing 0 units to producing 1 unit.

Marginal cost curves slope upward because it is assumed that the cheapest technologies for production will be exhausted first, and increased production will therefore be associated with an increase in per-unit production costs. The increase in MC associated with increasing production can come from factors such as exceeding plant capacity, having to transport raw materials from farther away at greater costs, or having higher management costs associated with a larger operation.

Let's look now at a number of questions about this graph to illustrate its conceptual similarities to the demand curve. First of all, what is the total cost of producing 10,000 notebooks? The total cost of producing X number of units is the area under the marginal cost curve between Q=0 and Q=X., so the total cost of producing 10,000 notebooks is $50,000.
What is the total cost of producing 25,000 units? Again we calculate the area under the marginal cost curve:

$50,000 +$70,000 + $50,000 = $170,000

Now, if the open-market price of notebooks is $8.00, how many are we going to produce? We will choose to produce (or supply) 20,000 notebooks; if we produce additional notebooks, the cost of producing each notebook ($10.00) will exceed what we receive for it, and we will lose money on production.



If the open-market price of notebooks is $20.00, how many are we going to produce? In that case we will choose to produce 40,000 notebooks.
Just like a consumer will continue to consume as long as marginal willingness to pay is greater than price, a producer will continue to produce as long as price is greater than marginal cost. As long as they are paid for that next notebook more than it takes them to produce that next notebook, they will continue to produce notebooks.

This marginal cost curve therefore reflects how many notebooks the firm will produce, or "supply" in response to various prices, so it is equivalently known as a **supply curve**. The supply curve illustrates how much output a firm (or an industry) is willing to provide at a given market price.

So we have seen that the marginal willingness to pay curve is equivalent to the demand curve, and the marginal cost curve is equivalent to the supply curve.

The concept of **producer surplus** is analogous to the consumer concept "consumer surplus". Producer surplus is equal to the difference between what we receive, as a producer, for a good (its price) and what we have to pay to produce it (its marginal cost which is $5 in our example). Suppose that the market price of notebooks is $10.00. We know that we will produce the first unit of 10,000 notebooks, and on each notebook we will earn a producer's surplus of $10.00-$5.00= $5.00, giving us $50,000 in producer's surplus on the first 10,000 notebooks. We will also find it worthwhile to produce the second unit of 10,000 notebooks, for each of those notebooks will yield a producer's surplus of $10.00- $7.00=$3.00, giving us $30,000 in producer's surplus on the second unit (or $80,000 overall). But should we produce any more notebooks than that? Additional notebooks will cost us $10.00 to produce, but we will only earn $10.00 for them, so we will have no producer's surplus for producing them. We are actually "indifferent" between producing and not producing them. Certainly, we will not produce any more than 30,000 notebooks, as above that point each notebook actually costs us more to produce than we can sell it for.

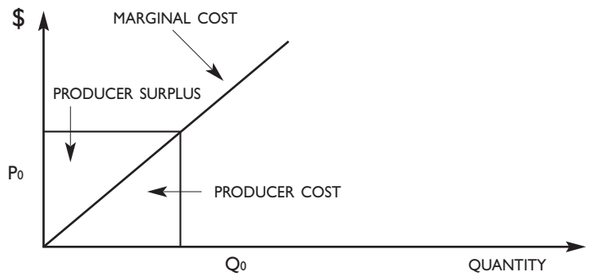
Just as consumers are made better off by transactions in which they are willing to pay more than they have to pay, producers are made better off by transactions if they receive for a good more than they pay to produce it- i.e. if they earn producer's surplus. In general, Producer surplus= Revenue (price times quantity sold) - Total cost of production.

### Producer Surplus

Producer surplus measures the difference between what a producer (either a firm or an industry) receives for a good and what it costs to produce that good. It is used as a measure of producer welfare at a particular production level and market price. The producer surplus associated with a particular price/quantity combination (P0,Q0) is equal to the revenue from that level of production (P0*Q0) minus the total private cost of that level of production. Total private cost is measured as the area under the marginal private cost curve from Q=0 to Q=Q0 (figure 2.5).

ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

Figure 2.5: Producer Surplus




## 2.4. Market Behavior and Efficiency

Now we're going to move on to analyze the concepts of how supply and demand regulates the production and consumption of goods in a market economy.

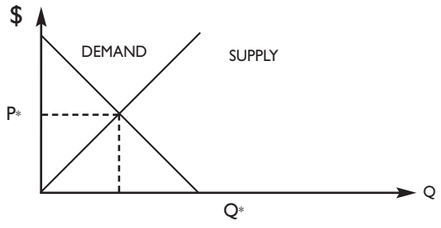
**Economy:** A particular system of organization for the production, distribution, and consumption of all the things human beings use.

**Market Economy:** A type of economic system where supply and demand regulate the economy rather than government intervention.

A market for a particular good is characterized by a demand curve for that good which illustrates how consumers value it (through their willingness to pay). The supply curve for that good illustrates what it costs to produce incremental units of that good and therefore how many units would be provided in response to different price signals.

What will happen in a market economy where consumers are characterized by the demand curve and producers by the supply curve (figure 2.6)?

Figure 2.6: Demand and Supply




The market will settle down to a market equilibrium at Q=Q* and P=P*. This is because at this price, the amount supplied is equal to the amount demanded, and no one in the economy has the incentive to change their production or consumption behavior.



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

In contrast, if P were greater than P*, producers would receive a market signal (price) telling them to increase their production of the good, and they would produce at a level greater than q*. Consumers, however, are faced with a very high price, so they demand less of the good (according to their demand curve), and the market is characterized by excess supply: market supply exceeds market demand. Producers would lose money because of overproduction, and market interactions would drive the price of the good down.

Similarly, if price were less than p*, the reverse would happen; consumers would demand more than suppliers are willing to produce, and the market would be characterized by excess demand (market demand exceeds market supply). Under a condition of excess demand, competition among consumers would cause the price of the good to rise.

Over time what we see is that this balancing process happens in markets, where the price fluctuates for a while in response to the interaction between demand and supply. Eventually, however, the price will reach the equilibrium point illustrated above, where supply equals demand. At this (production, price) combination, producers manage to sell off all of their stocks, consumers get to buy as much as they demand and everybody is happy.

There is no incentive for the market to adjust any further, and the market is in equilibrium. It is called **Market equilibrium** because it is the point where supply and demand are balanced. And the amazing thing about the equilibrium point is that the market tends to move toward that point through this process that we just illustrated of constant adjustment in response to excess supply or excess demand.

We know that this is where the market tends to go, but is there any particular reason that we would want to be producing there? The market tends to go there, but is that the best place for it to be? As a society, are we somehow better off if the market is producing at that point rather than at any other point? The answer is yes, but the question now is why - what is so good about producing at this point rather than at any other one?

To answer this question, let's return to the concepts of producer surplus and consumer surplus. Conceptually, we explained consumer surplus as how much better off consumers are as a result of participating in a transaction, and producer surplus is how much better off producers are as a result of participating in a transaction. So since an economy is defined as consumers and producers together, we are going to define "economic surplus" as consumer surplus plus producer surplus.

Economic surplus at a production level Q0 is equal to consumer surplus at Q0 added to producer surplus at Q0. The easiest way to measure this is as total willingness to pay for Q0 units minus total cost of producing Q0 units. This is a measure of how much better off the economy is as a whole (producers and consumers together) as a result of engaging in a particular level of production/consumption. What we find in analyzing the economic surplus associated with different production points, is that economic surplus is maximized when the production point is Q=Q*. For this reason, the equilibrium (P*,Q*) combination may be considered "optimal" from an economic standpoint- it maximizes the economic surplus associated with production.

## 2.5. Market Failures

We showed how markets tend toward a production level at the intersection of the supply and demand curves. This is also the point at which the marginal benefits to consumers of the good are exactly balanced with the marginal cost to producers of producing the good. If we choose to produce one more unit of the good, the costs to the producer would exceed the benefits to the consumer, and that last unit would therefore not be "worth" producing. If all the parties involved in the transaction are happy, then what is the problem?

The problem is that the above analysis is based on the fact that demand equals marginal benefit and supply equals marginal cost. However, not in all cases it is so. When at least one of the curves, demand or supply, either doesn't exist or does not equal to the marginal benefit or marginal cost curves respectively, then we say that there is a **market failure**: the market does not achieve efficiency (or equilibrium). This is the place where the government should step in.

We will describe the major market failures which relate to MPAs and will also deal with some public responses to these problems.

### 2.5.1. Externalities

The problem here is that market transactions often affect individuals who are not directly involved with buying or selling the good. Individuals may be adversely affected, for instance, by wastes that are generated during the production process. When this happens, the market is said to have externalities associated with production or consumption:

> EXTERNALITIES
>
> The positive (beneficial) or negative (harmful) effects that market exchanges have on people who do not participate directly in those exchanges.

When externalities exist, it means that the supply and demand curves we have discussed do not FULLY represent the costs and benefits of the good to society as a whole. Therefore, the market results in a production level that balances "private" costs and benefits, but not the full social costs and benefits associated with production. Most problems of active environmental degradation are related to the concept of external costs- people not taking into account the "true" cost of their activities in deciding on a course of action. These people can be either producers-polluter, producers generating a lot of waste, developers ruining the aesthetic quality of a beach etc, OR they can be consumers - driving a car on the beach nearby spawning places, littering (creating visual pollution and perhaps water quality problems) etc.

The full social cost of production, therefore, should include both the private cost (as represented by the supply curve) and the external costs generated by production. This is given by: Marginal social cost= marginal private cost (supply) + marginal external cost of production



Similarly, the social benefits of production are measured by the marginal social willingness to pay curve, which are composed of both the marginal private willingness to pay (as measured by demand) and the externalities associated with consumption:

Marginal social willingness to pay= marginal private willingness to pay (demand) + marginal external benefits of consumption.

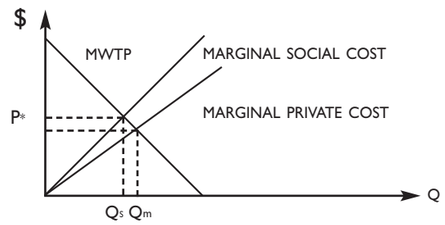
The truly socially efficient production point, therefore, is the point where marginal social cost= marginal social willingness to pay. The market, however, tends toward to the point where marginal private cost (supply) equals marginal private benefit (demand); these points do not coincide unless there are no external costs or benefits associated with production or consumption of the good.

### What are some examples of externalities?

Externalities can be either positive or negative, and they can affect either the costs or the benefits of production. An example of a negative externality in production would be when one farmer's crop spraying kills beneficial insects downwind that a neighboring farmer relies on pollinating his crops. The upwind farmer's private cost schedule (his supply curve) does not take into account the cost that his activities are imposing on his neighbor, which would be considered an external cost. The full social cost of his productive activity must take into account both sources of cost:

When production of a good entails external costs such as degradation of air or market quality, the free market (Pm, Qm) is likely to result in overproduction of the good relative to what is socially efficient (Ps, Qs) (figure 2.7).

**Figure 2.7: Negative Externalities**

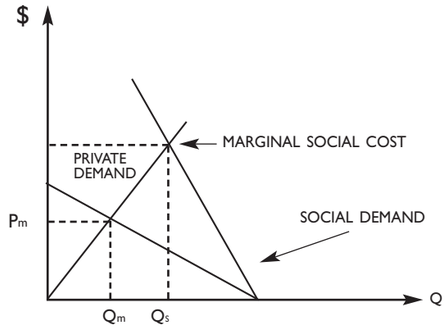



*Note: This graph assumes that there are no externalities in consumption, so demand is equivalent to marginal social willingness to pay.*

An example of a positive externality associated with consumption would be seen if purchasing landscape services and improving the landscape quality of my property increases the quality of life (as well as the property values) of all of my neighbors. In deciding how much to purchase of "landscape quality", I do not consider these external effects- i.e. my neighbor's satisfaction doesn't enter into my decision about whether landscape quality is worth the cost.

Therefore, my private demand curve, which is supposed to reflect the "value" of that good, doesn't capture the full social benefits, and therefore the social value, associated with that good (figure 2.8):

Figure 2.8: Positive Externalities




As illustrated in the graph above, when consumption of a good entails social benefits that are not captured by private demand (marginal external benefits), the free market is likely to result in underproduction of that good ($P_m$, $Q_m$) relative to what is socially efficient ($P_s$, $Q_s$).

As you can see from the graphs, in the presence of externalities, the market fails to produce at the socially efficient production level. This is because the price at which the good is traded in the market place does not fully reflect the social costs and benefits associated with production and consumption of that good; it only reflects the private costs and benefits of the good.

The point of production that society as a whole would prefer is that point where marginal social willingness to pay (which is also called marginal social benefits) is equal to marginal social costs. This is the point where the net social benefits of production, or social surplus, are maximized. It measures how much better off all of society is as a result of trade, not just the producers and consumers involved in the transaction. Essentially, it takes into account external costs and benefits of production.

> **Social Surplus**
>
> A measure of the amount by which the social benefits of consumption exceed the social costs of production for a particular level of production/consumption.

Also known as the net social benefits of production, this measure is used as an indicator of society's overall welfare at a particular level of production when both external costs and benefits are taken into account. The social surplus associated with Q=X is measured as the Total Social Willingness to Pay for Q=X minus the total social cost of Q=X. On a graph, this is represented as the area between the marginal social willingness to pay curve and the marginal social cost curve between Q=0 and Q=X.



Social surplus is maximized when the production level is Qs, which is why this level is considered the socially efficient, or socially optimal, production level.

So, this section has illustrated an example of market failure; when externalities exist in either production or consumption, they result in market failure. Market failure means that because the price signals in the marketplace are wrong, the market fails to result in the socially efficient, or socially optimal, production level.

### Why do externalities exist?

The problem of externalities is essentially one of lack of property rights associated with certain inputs or outputs from the market economy. Market economies are based on the concept of private property. They assume that all resources going into the market, or affected by market production, are owned by somebody, and if you want to use or degrade a resource in some way, you will have to bear the cost. The equivalence of market equilibrium and economically optimal production levels assumes that all of the resources that form economic inputs or economic outputs have property rights specified for them. In other words, markets only work to efficiently allocate resources if everything that they "touch" or affect in some way has property rights assigned to them.

What exactly are property rights? According to Tietenberg (2004): "...Property rights refer to a bundle of entitlements, privileges, and limitations defining the owner's rights to use a resource..."

An efficient property rights structure has four characteristics:

1. *Universality*: All resources are privately owned and all entitlements are completely specified.

2. *Exclusivity*: All benefits and costs accrued as a result of owning and using the resources should accrue to the owner, and only to the owner, either directly or indirectly by sale to others.

3. *Transferability*: All property rights should be transferable from one owner to another in a voluntary exchange.

4. *Enforceability*. Property rights should be secure from involuntary seizure or encroachment by others.

The general idea is that if you have a resource with property rights associated with it which satisfy all of these criteria, the owner of that resource will have the incentive to maintain its quality because any deterioration in quality translates into personal loss (loss of value upon transfer, loss of use value, etc.).

Property rights therefore provide the incentive for proper use of the resource.

What do property rights have to do with the market forces that we have been looking at? Let's start by thinking about the concept of a supply curve. This curve is supposed to represent the full costs of producing a good, say a shoe. But if there are resources that are used in the production of that shoe that are not privately owned (i.e. a clean river that flows into the sea), then if the pro-

duction process damages or compromises those resources in some way, there is no one who technically has to be compensated because there are no property rights assigned to this resource.

And yet there are people who are hurt or inconvenienced by that damage, so a cost accrues to society, but there is nobody who can step forward and demand compensation. If the company is not forced to compensate for that external damage to an un-known resource, the cost of that external damage doesn't appear as expenditure in the ledgers of the company producing the good, and the company doesn't take it into account in calculating the costs of production. Production of the good therefore seems artificially "cheap"- this will result in overproduction of the good, and the price of the good will not reflect the fact that producing it results in damage to resources that are unprotected by a system of property rights.

Therefore the market fails in the presence of externalities- it fails to result in a socially optimal distribution of resources and a socially optimal production level. There are other scenarios under which the market fails to operate well. What else does the market do badly?

1. The market cannot deal properly with the incidental side effects (i.e. external costs) associated with economic activities (We've covered that one).

2. The market cannot provide **public goods** (which we will relate to in the next section).

3. The market does a poor job of allocating resources between the present and the future (this will be dealt with in section 4.3).

4. The market considers only efficiency issues. However, the income distribution generated by the efficient allocation of resources requires a set of normative considerations that lay beyond the traditional framework of economics. Yet, we will deal with what economics has to say about distributional issues in section 4.6.

### 2.5.2. Public Goods

One way to eliminate externalities in production would be to assign property rights to every input affected in even the slightest way by market production. Let's think about this in theory. Would a fully defined system of property rights such as this one solve the problem of the social costs generated by a firm causing pollution as a side effect of its production process, for instance? It would certainly help, because every resource degraded by the production process, whether it is air, water, ozone or forests would be owned by someone. If something is owned by someone, you can't just destroy it without compensation. Polluters would now have to pay for the right to pollute; all of a sudden what was once a social cost is now a private one, out of pocket expenditure that enters into a firm's marginal cost curve and affects the firm's decision about how much to produce and how much to pollute. This is a process called "**internalizing the externality**"- the process of converting the external costs of production, which do not enter into a firm's marginal cost calculations- into a private, out-of-the-pocket expenditure that does enter the firm's marginal cost calculations. If all costs were taken into account in a producer's production decision, assuming no externalities associated with consumption, the market would result in a socially efficient level of production.

With respect to the environment, however, there are certain characteristics of environmental goods that make them very difficult to assign property rights to. A large number of environmental and natural resources, including MPAs have characteristics that make private property infeasible, such as ambient air quality, water in streams, rivers, lakes, and oceans and migratory wildlife species. These resources are all examples of public goods; they share certain characteristics that make them extremely difficult to assign private property rights. Those characteristics are **non-rivalry** and **non-exclusivity**.

*Non-rivalry:* A good is said to be non-rival when one individual's consumption of that good does not diminish the amount of the good that is available for consumption by other people. An extreme example of a non-rival good would be watching the sunset from a beautiful beach; the fact that I enjoy the sunset immensely does not in any way detract from the amount of enjoyment left for other viewers.

*Non-exclusivity:* One of the requirements for a fully specified system of property rights is that the costs and benefits of use be exclusive to the owner. But in the case of the sunset seen from the beautiful beach, it is simply impossible to assign exclusive right to enjoy it (use it). Even if there was an owner to that beach, it would not be possible for the owner to exclude other people from the enjoyment (use) of the sunset.

A public good is therefore one that, if made available to one person, automatically becomes available to others. For this reason, public goods are said to be "jointly consumed"- if one person consumes them, anyone can. Classic examples used to illustrate the concept of a public good are a lighthouse and national defense. Most environmental quality improvements fall under the category of public goods. Unfortunately, we cannot rely on the market to provide public goods at a level that is socially optimal. One reason is because when the good has characteristics of a public good, individuals in the market place have the incentive to "free-ride" on the supply of the good provided and paid for by other people. These would be individuals who would like the good to be supplied, but don't want to pay for it, like ship-owners not paying for the service provided by the lighthouse owner, waiting for others to do it. With normal market goods, this isn't possible- you can't enjoy the benefits of a good without paying for it, or without special permission from whoever owns the good. With public goods, however, this isn't the case. You know that even if you don't supply the good, somebody else might, and you would get to enjoy the good anyway. So you have the incentive to chip in less than what you are truly willing to pay, and hope that other people's contributions make up the difference.

Another reason that the market fails to provide public goods at the socially efficient level is that public goods represent an extreme case of positive external benefits in consumption. For example, I keep a clean beach which other people benefit from it as well. Although private demand curves drive individual demand for a good, and therefore an individual's incentive to participate in market transactions for the good, these private demand curves come nowhere near capturing the full social benefits associated with consumption of each unit of the good. When we aggregated demand for private goods over individuals to arrive at an aggregated demand curve (section 2.4), we simply summed the individual demand curves horizontally. In

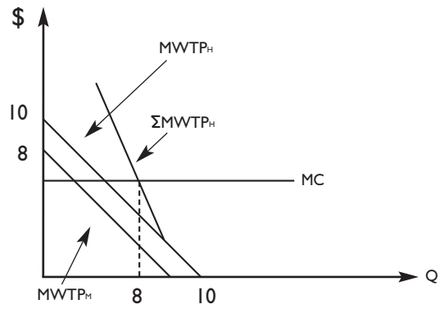
other words we calculated for each price level, what the quantity demanded would be. When the good in question is a public good you calculate aggregate demand curves differently. With public goods, consumers essentially consume the same units of good- public goods are jointly consumed. If one unit of the good is provided, all consumers in the market place consume it. If one unit of cleaner beach is provided, all of the consumers in the marketplace benefit from it. So to determine the total value of providing that unit to the consumers, we need to add up each of their individual values to reach the true social value. Whereas the value of a unit of a private good is its maximum value to one individual (whoever is willing to pay the most for it), the value of a unit of a public good is the sum of its values to all individuals, since all individuals will benefit from its provision (This is called "vertical" summation of the individual demand curves).

To understand this more clearly, let's look at an example. Suppose that you have two individuals who derive some pleasure from a public good and are therefore willing to pay some amount toward the provision of that public good, such as a clean beach. Their names are Helen and Mark and their respective MWTP curves are represented by these equations:

Helen: $MWTP_H = 10 - Q$
Mark: $MWTP_M = 8 - Q$

These equations would appear on graph 2.9 as shown:

**Figure 2.9: Provision of a Public Good**




The curve representing social value, or society's marginal willingness to pay, can easily be calculated by aggregating the curves representing individual willingness to pay, being careful to account for kinks in the curve that arise when an individual's willingness to pay goes to zero:

$$TMWTP = \begin{cases} 18 - 2Q & \text{for } Q \leq 8 \\ 10 - Q & \text{for } Q \geq 8 \end{cases}$$

Now suppose that the cost of the public good is a constant $5.00 per unit. How many units of the good do you think the market will provide? In other words, how many units of the good will these individuals consume?



This is a public good, so assume that neither individual can prevent the other from free-riding. In other words, an individual will benefit from the good **whether they purchased it or not**. Therefore, although we can not be entirely sure by looking at the individual marginal willingness to pay curves whom exactly will purchase the first three units of good, we can tell that no more than 5 units of the good will be purchased by either of them. This is because once both individuals have five units of the good; their willingness to pay for an additional unit is less than what that unit would cost, $5.00, so neither would find it in their personal interest to pay out the whole $5.00 to provide one more unit.

The socially optimal provision level, however, as indicated in the graph, is at slightly less than 7 units- it is at the point where the aggregate marginal social willingness to pay curve crosses the price line. For all units up to this point, the benefits of provision (as measured by the social marginal willingness to pay) exceed the costs of provision (as measured by price). Additional units, however, are not "worth it" for the individuals in society, because the cost of provision exceeds the aggregate benefits.

If Mark and Helen got together, they might decide to purchase additional units (beyond 5 units) and split the cost of the good; this might ultimately result in the socially optimal level of provision of the good. However, the tendency to free-ride may lead one or the other to understate their true willingness to pay for additional units while in cooperative negotiation, which would undermine the movement toward the socially optimal provision level.

Another problem with assigning private property rights to environmental resources is enforceability; even though the government may attempt to define rights to some resources (such as maintaining ownership rights 200 miles out to sea, setting hunting limits, banning the use of certain chemicals, and prohibiting dumping it is often difficult to enforce these rules given the large area that would have to be patrolled in order to enforce it.

## 2.6. Summary

Economic efficiency is reached when markets operate with well defined property rights. It was shown in this chapter that whenever this is the case, the private solution of how to allocate resources is efficient. By efficiency we mean that there is no other allocation of resources where the net benefit of the human use of these resources can be higher.

However, in most environmental and natural resources allocation situations, this is not the situation. Markets do not reach efficiency since property rights are not well defined or sometimes do not exist at all.

The cases where property rights are ill defined are terminated as externalities. We distinguish between negative and positive externalities. Both are important in understanding the nature of the problems MPAs deal with and why were they created in the first place. Examples of negative externalities might include Sea pollution while positive externalities might include a private beach that increases the value of nearby locations.

The cases where property rights do not exist at all are determined as public goods. Here the essence of the good is that it is non-excludable and the benefits of one person using the

resource do not decrease the benefit of others. This situation results in a negative incentive to pay for this service by anticipating that others will. The final outcome is that these goods are not provided at all or provided in less than their efficient amount. Examples might include endangered species as well as beach preservation without privatizing it.

MPAs can be thought of as the solution for these market failures. If the market can not provide them or it provides them in a smaller amount than the desired one, the government has a role to correct this situation. How to do it will be described in sections 4 and 5. But before doing that we would like to pay attention to another problem that MPAs might be the solution for. The case of over exploitation of fisheries which is a mixture of externalities and public good characteristic of the Oceans. This will be described in section 3.

### 2.7. Further Readings

Three good references for studying the mechanism of market economics, microeconomics and market failures are:

1) Mankiw, G. *Principles of Microeconomics*. Forth Worth TX, Dryden Press, 1998.

2) Nicholson, W. I*ntermediate Microeconomics and its applications with Economic Application Card*. 9th ed. South Westen College Publishing, 2003.

3) Pyndyck, R.S. and D. Rubinfeld D. *Microeconomics*. 6th ed. Prantice Hall, 2004.



# 3. Bio-Economics Modeling

### 3.1. Introduction

Marine protected areas are designed not only to protect the environment but also in order to better manage the fisheries in the area. The problem of over fishing has caused severe damages to fishermen around the world. This section will describe how the problem evolved and present possible solutions. It should be noted that in contrary to other sections, this one deals with exploitation of marine resources and NOT with preservation. However, the basic economic tools are the same but are combined with biological growth factors.

### 3.2. The General Model

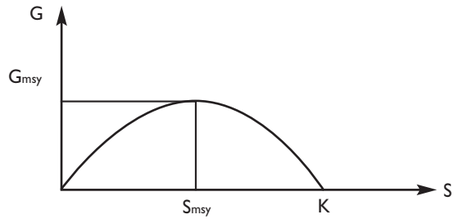
Fisheries may serve as an example to natural resource application where economic models have been most closely integrated with biological models to produce policy and management recommendations. Fisheries are a renewable natural resource whose profitable and sustainable exploitation by humans is strongly dependent on stock size. This interaction is further complicated by the fact that many of the world's fisheries are, for all practical purposes, open-access resources and they have no single legal "protector" who restricts access when the stock is at risk. Actually, we might think of an open-access resource as a semi-public good - we can't keep others form fishing (non-excludability) but once I caught a fish, it belongs to me (rivalry). These bio-economic models are used primarily to answer questions about what the "efficient" stock size and harvesting effort should be in a given fishery.

This section introduces a basic bio-economic model of fisheries and the interaction between biological models and economic (or harvesting) models. The biological model consists essentially of a logistic growth curve that provides an illustration of how fish stocks of different size can be expected to increase in biomass each year:

In figure 3.1 we can see that when the population is very small (stock=0) or very large (stock=K), it does not grow very much in any given time period. K represents the environmental carrying capacity of the stock's habitat; if the stock is large enough to be at its carrying

capacity, it cannot continue to grow, because resources are already being exploited at their maximum sustainable rate; should the population continue to grow, death rates will exceed birth rates due to lack of resources, and the population would shrink back down to K. When the stock is quite small, on the other hand, there are simply not enough fish for the population to produce a large amount of additional biomass in each time period.

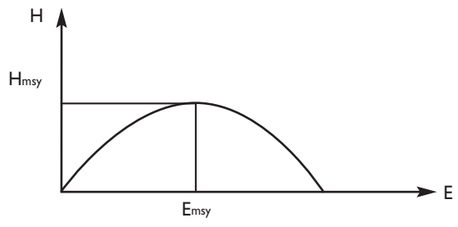
Figure 3.1: Stock-Growth Function




The economic model of the fishery introduces the concept of harvest and the population response to it. We will assume that an inter-temporally efficient management scenario must be one that ensures a sustainable harvest from the fishery, rather than a "boom and bust" approach to harvest5. In any given harvest period, if you were able to just "skim" off the growth in biomass that had occurred in that time period, you would be able to maintain the fish stock at a constant size. The growth function above also represents, therefore, the sustainable yield that is associated with any given stock size; sustainable yield is therefore maximized when the population is maintained at the level marked $S_{msy}$ (**Sustainable Maximum Yield**) in figure 3.1. We have, therefore, identified the point at which sustainable yield is maximized, and this represents one possible management target for a fisheries population. But is the point of maximum sustainable yield the point at which it is economically optimal to maintain the fishery? In order to address this question we must know something about both the costs and benefits of harvest.

In order to investigate costs of harvest, we must consider that stocks can only be harvested given a certain amount of harvesting effort, and that this effort will have a cost associated with it. Fishing effort refers to all the time and resources devoted to harvest; it may be measured in a number of ways- as number of trawlers, size of nets, or fishermen work hours. Let's combine harvesting efforts with the biological model introduced above (figure 3.2).

Figure 3.2: Effort - Yield Curve



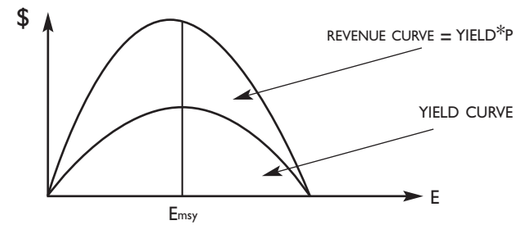





As can be seen from figure 3.2, it assumes an inverse relationship between fishing effort and stock size; as effort levels increase, the sustainable population size falls. When E=0, the stock is not harvested, and population size is determined only by environmental factors, so stock will be at K, its carrying capacity. When E is at $E_{max}$, enough harvesting pressure is placed on the fishery to drive its population level to zero.

Before we attach a dollar figure to the costs associated with fishing harvest, we will look at the benefits associated with harvest. The benefits are measured as the revenue associated with harvest, which can be easily derived from the figures above. Assume that each kg of biomass landed is sold on the market for a fixed price, P. The yield curve above can therefore be multiplied by some constant P to create a revenue curve that has the identical shape, but is scaled differently on the y axis. This is shown in figure 3.3:

Figure 3.3: Effort Revenue Curve

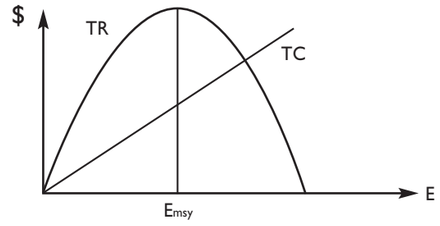



This curve is a measure of the total revenue associated with each harvest level; and is equal to the yield multiplied by the price received. Calculating total costs is done by multiplying the amount of effort by its costs. If we assume that every unit of effort has a cost, w, associated with it, then the total cost of effort at each effort level is:

Total Cost= Effort * w.

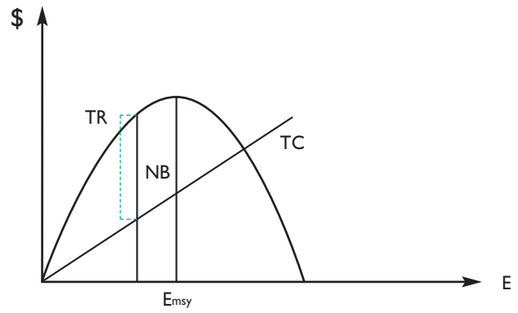
Thus, the total cost curve, plotted against effort, is a line through the origin with positive slope equal to w. This is shown in figure 3.4:

Figure 3.4: Total Revenue and Cost Curves



We have now completed the transition from a biological model to an economic one, and we can return to the question, what is the "efficient" management point for the fishery? In defining that point, we are using efficiency in the economic sense- the efficient management point is the point at which net benefits from the fishery are maximized. We have already been introduced to the point of maximum sustainable yield, which is associated with the effort level Emsy above, but since that point includes no reference to cost, it shouldn't be a surprise that it is not the economically efficient effort level. Instead, the economically efficient effort level is the point where net benefits are maximized, which is the point where MReffort=MCeffort. This point is identified on the graph above as the point where the slope of the total revenue curve is equal to the slope of the total cost curve. This point is found by locating the point where a line of equal slope to the total cost curve is exactly tangent to the total revenue curve. This is shown in figure 3.5.

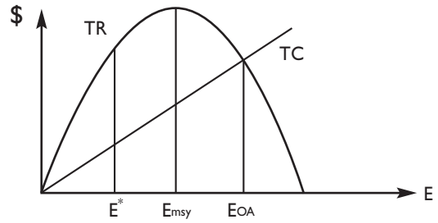
Figure 3.5: Maximum Net Benefit




The efficient harvest level for this fishery, E*, is therefore lower then the effort level associated with the maximum sustainable yield, $E_{msy}$. Since effort is inversely related to stock, this means that the economically efficient stock level is larger than the stock level required for the maximum sustainable yield. Although the maximum yield provides the maximum revenue, it does so at higher costs. Hence, it is economically efficient to allow a higher stock so that the effort expended on harvest is lower.

Early in this section, fisheries were introduced as a classic example of an open-access resource. What are the implications of this for fisheries effort levels? The fact that fisheries are open-access means that as long as there are positive profits in fishing, an incentive will exist for more fishermen to enter the fishery, which increases effort and decreases stock level. Unless access is restricted, the industry will continue to expand as long as net revenues are positive. This means that, although net revenues are maximized at E*, an open-access fishery will not remain at that effort level, because the presence of net revenues will automatically draw additional effort into the fishing area. This process will continue until net revenue is driven to zero, at which point there will be no further incentive for entrance into the fishery, and the effort level will stabilize. This point is located at the effort level where TR=TC; at this point the effort is much higher than the efficient effort level, and the high effort drives the stock level down to a level much lower than the efficient stock level. This is shown in figure 3.6:

Figure 3.6: Open Access vs. Efficient Effort Levels




The point marked $E_{OA}$ is called the open-access equilibrium; it represents the point at which effort level stabilizes, and there is no further incentive for additional entrants into the fishery because net revenue has been driven to zero. Notice that if the per-effort unit costs of fishing, w, were to decline, the total costs curve would drop, leading to more effort at the open-access equilibrium, and an even smaller stock level. This is an example of "**The tragedy of open-access**" (or "The tragedy of the Commons").

### The Tragedy of the Commons:

Ecologist Garrett Hardin's "tragedy of the commons" (Hardin, 1968) has proven a useful concept for understanding how we have come to be at the brink of numerous environmental and natural resources catastrophes. People face a dangerous situation created not by outside forces but by the apparently appropriate and innocent behaviors of many individuals acting alone.

Hardin's demonstration involves a pasture "open to all." He asks us to imagine the grazing of animals on a common ground. Individuals are motivated to add to their herds in order to increase personal wealth. Yet, every animal added to the total, degrades the commons by a small amount. Although the degradation for each additional animal is small relative to the gain in wealth for the owner, if all owners follow this pattern the commons will ultimately be destroyed. Being rational actors, each owner indeed adds to his herd.

Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit - in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own interest in a society that believes in the freedom of the commons (Hardin, 1968).

Yet if all that was at stake here was grazing land in the 1800's, this would be an issue for historians alone. Hardin immediately recognized that this concept applies in its broader

sense to a great many modern environmental and natural resources problems (e.g., acid precipitation, ocean dumping, atmospheric carbon dioxide discharges and over fishing in our case). Simply stated, we face a serious dilemma - an instance where individual rational behavior (i.e., acting without restraint to maximize personal short-term gain) can cause long-range harm to the environment, other people and ultimately oneself.

With a clear definition of the common's tragedy, researchers have focused on explaining the conditions under which it is most likely to arise. It is noteworthy that not all resource management situations lead to a tragedy. Certain fundamental conditions must exist before a tragedy can emerge. The first condition involves the nature of the resource itself. One must distinguish between a public good and a commons, or what has come to be called a common-pool resource (CPR). In the public good case another attribute is the non consumptiveness. One's use of the resource does not reduce the availability of it to others. In fact, users of a public good care little about who else uses it. Likewise, all users benefit from the maintenance of a public resource (e.g., weather forecasting computer, bridge) whether or not they help pay for the maintenance. CPR, on the other hand, is a semi public good. That is because if one more fisherman gets into the fishing ground, it does affect other fishermen.

The second fundamental condition focuses on access to the resource. A tragedy is more likely to emerge in a situation where restraining access to the resource is costly, impractical or impossible. Hardin's predictions for the inevitable over-exploitation of a commons were based solely on consideration of open access situations. And in fact, case studies document that tragedies do occur when an open-access system supplants a pre-existing successful CPR management system. Fishing in the open sea can, therefore, create a tragedy problem. However, MPA creation can solve part of the problem by managing the resource in a social way.

The open-access equilibrium is considered inefficient, because better use of the fishery, in terms of generating net revenue, could be made if access were restricted and the effort level were lowered to E*. Note that the efficient point could also be considered "better" biologically; a larger stock level may be considered "better" because it has a greater buffer against the risk of chance extinction due to unforeseen environmental factors.

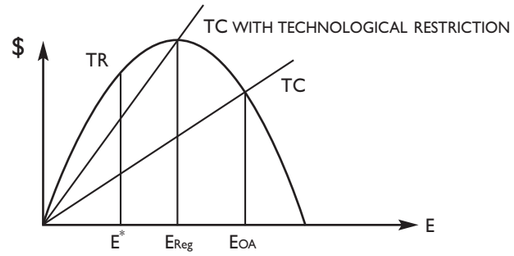
### 3.3. Regulating Open Access Resources

Again, we consider fisheries as a representative example to open access resources. There are basically two approaches to regulating the effort level in a fishery. The first is to work within the existing open-access structure and modify the behavior of fishermen in some way. Such policies include mandating how fish can be caught (i.e. specific technologies), what size of fish can be caught, when and where fish can be caught (i.e. season restrictions or marine reserves), or simply how many fish may be caught (the season is closed when a certain tonnage of fish is landed.). There are many problems with these approaches, including unsafe fishing conditions when the season is restricted (in some cases to only 24 hours) and overcapitalization of fisheries; In addition, an economist would argue that increasing the cost of fishing by mandating or prohibiting certain technologies, does not represent an efficient



solution to the fisheries regulation problem. Efficiency, after all, is concerned with maximizing net returns to the fishery; enacting policies that prohibit the use of radar, for instance, would reduce the effort (and the harvest) by increasing the cost of harvest, but will do so only by "wasting" resources that could have been saved by using radar. Another example of mandated technology can be found in certain parts of the Chesapeake Bay, where oysters can only be harvested from non-motorized boats. An economic analysis of such regulations is illustrated in figure 3.7 below:

Figure 3.7: Regulation in Open Access Fisheries




The graph above illustrates that increasing costs will in fact reduce the effort (and therefore the harvest) to a level closer to the harvest level that was originally efficient. However, at this new effort level, net revenues are still zero, and given the new cost curve the efficient effort level would actually drop even further to reflect the higher cost of fishing. Such technology restrictions protect the stock, but do so in an economically inefficient way.

An alternative approach to fisheries management is to limit entry. Assigning property rights to the fishery would allow its new "owners" to determine an appropriate exploitation rate. However, it would be extremely difficult to assign and enforce property rights to most of the world's fisheries, particularly marine fisheries. An alternative, innovative approach to limiting entry has been to establish systems of individual transferable quotas (ITQs), which are also called IFQs- individual fishing quotas. A fixed harvest is decided upon, quotas are distributed in some way, and markets develop in which quotas are exchanged when new entrants wish to enter the fishery or old participants retire. Just as with TDPs, one major issue is deciding how to allocate the quotas in the first place- these quotas have a market value because they represent a valuable "entitlement" to participate in the fishery. The original allocation of quotas therefore represents a distribution of wealth to interested parties.

Since the 1980's ITQ systems have been set up to manage fisheries in countries around the world, including Canada, Australia, New Zealand, and Iceland by their respective governments. In 1984, Australia initiated an ITQ system for the Southern Bluefish Tuna (SBT), whose population was declining sharply (Kennedy and Pasternak, 1991). Although the ITQ system did result in a lower total SBT catch, it also had a significant impact on the fleet structure of the fishery; many smaller fishermen and fishermen who didn't specialize in tuna sold off their quotas and exited the fishery. The result was a drastic reduction in the number of boats fishing for tuna, but a higher catch per boat. This concentration of quotas in the hands of larger fishing operations is one reason organizations such as Greenpeace object to the

concept of ITQs. However, the tuna population had stabilized by 1994, and a sustainable annual quota amount, which is split between Japan, Australia, and New Zealand, seems to have been identified.

In the United States, four ITQ programs have been in operation since the early-mid 90s- the mid-Atlantic Surf Clam/Quahog fishery, Alaskan Halibut, Alaskan Sablefish and South Atlantic Wreckfish. In response to opposition to ITQ programs, however, Congress passed a moratorium on the development of further ITQ programs in 1996, which expired in 2000. In the meantime, the National Research Council completed a report containing their recommendations for a national ITQ policy. The executive summary of that report (located at http://books.nap.edu/html/sharing_fish/#Summary), provides more detailed information on the pros and cons of ITQ systems.

## 3.4. Case Studies

**Case study 1:** Agnello and Lawrence (1979) studied the problem of Oysters in Maryland, Virginia, Louisiana and Mississippi. Oyster beds operate both in private as well as open access environments. This enabled the researchers to compare quantities and behavior across regimes since the product is sold at the same market. Major findings of the research were:

- The ratio of early season catch to the later part ranged from 1.35 in the open access regime to 1.01 in the private property regime. This is an expected result since, as we have seen earlier, open access fishermen tries to fish earlier otherwise somebody else would.
- The ratio of income of private property fishermen to open access was 1.53 on average and picked up to 3.69. This is expected since, as we have seen before, fishing in an open access environment depleted the economic rent while fishing under private property rights maximizes the rent.
- The ratio of prices in markets served only from private property beds to those markets served only from open access beds was found to be 1.29. This is also expected since fishermen at open access environment are driven to catch and sell as many fish as they can, while fishermen in private beds respond more easily to market conditions.

**Case study 2:** An estimate of the social loss of unregulated fisheries was done on the Lobster industry in Eastern Canada by Henderson and Tugwell (1979). Their results are summarized in the following table.

**Table 3.1: Lobster's Catch in Different Management Scenarios**

| | Optimal solution | Free entry |
|---|---|---|
| Lobster stock (thousand lb) | 2450 | 1125 |
| Lobster catch (thousand lb) | 801 | 936 |
| Effort (traps) | 122 | 365 |
| Ratio: Catch/Stock | 0.33 | 0.83 |

Source: Henderson, J.V. and M. Tugwell (1979). Exploitation of the Lobster Fishery: Some empirical results. Journal of Environmental Economics and Management. 6: 287 - 296.





As can be seen from the table, the stock under a free access situation is less than half than it would have been under optimal policy. That means much more effort to catch the lobsters as can be seen from the effort in both cases. Revenue under free entry is higher because catch is higher, but this falls short of the high cost associated with the free entry policy. The authors found that the loss in profits was estimated by about 25% of the market value!

## 3.5. Summary

Marine protected areas can serve not only for preservation purposes but also for efficient exploitation of the fisheries. Fishing in the open seas creates a market failure described as the tragedy of the commons. Under this market failure we observe over-exploitation and in turn decreased income and stocks of fish. In some cases it can bring to extinction.

MPAs have a special role in solving this problem. They can be used when the fishing ground is located within the territory of one country but one can think of a situation where the MPA is an international one, belonging to two adjacent countries or even more. MPAs actually operate as treating the entire fishing ground as one entity which is then managed in an efficient way. This is usually done by licenses, specific fishing dates, size limits on boats, nets and number of crew and more.

## 3.6. Further Readings and additional references

**Further readings - Some classical and historically important papers:**

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# 4. Benefit-Cost Analysis (BCA)

## 4.1. Introduction

Should we pronounce a commercial area as an MPA and by that restrict commercial uses in the area? How many square km. in the sea or miles on the beach should we preserve? These are the kind of questions dealt with in Cost-Benefit-Analysis (CBA). The procedure has relatively simple steps to follow, which is why it is popular in public decision making. However, the procedure is also very controversial on several grounds.

We will demonstrate the important issues in CBA and will explain some of the controversies associated with it. In general, CBA is a procedure that evaluates public programs according to their benefits and costs. However, they are not measured in terms of revenues and expenses but take a broader perspective by looking at benefits and costs from a social perspective.

Still, the method is controversial because of two main reasons: first, it tries to value species and other organisms that have high sentimental value but never thought of by the ordinary person in terms of dollars and cents. Second, CBA totally ignores distributional issues but rather deals with what is determined as Net Benefit. We will deal with that in a later section.

## 4.2. Traditional Benefit Cost Analysis

Up until this point, we have been looking at the theory underlying our approach to preservation policy. We have concluded that we would ideally like to be able to identify the preservation efforts such that marginal benefit of the last unit preserved damage is equal to its marginal cost. The next step would be to establish a policy that will either induce or force firms to operate in a way that their behavior is equal to that socially efficient preservation level. Unfortunately, in practice, it isn't that simple; regulators don't usually have access to either perfect information about marginal preservation levels or about marginal costs of these efforts.

This means that in practice, we can't identify the socially efficient preservation level, nor can we know with certainty how firms as a group will respond to taxes and subsidies set to particular levels. So what do we do?

In a practical regulatory situation, what regulators often do instead is use their understanding of economics and of environmental dynamics involved in a particular problem, to isolate a few possible policies that could be used to mitigate the problem. Then in order to determine whether these policies are in fact desirable policies or projects, regulators conduct extensive analysis of the benefits and costs associated with those different policies. Such an analysis is called a **Benefit/Cost Analysis** (BCA). Benefit-cost analysis has been one of the most widely-used tools for helping to make public decisions regarding policies with environmental impacts; it has been used to compare the costs and benefits either of physical public projects (dams, water treatment plants, beach and habitat restoration and land preservation) or of regulatory programs, such as the clean air and water acts, etc.

A BCA involves identifying every possible cost and benefit associated with a proposed project or policy, quantifying and aggregating those costs and benefits, and then comparing the magnitude of costs to the magnitude of benefits. If total benefits exceed total costs, the regulators would consider enacting that policy an improvement over not enacting any policy at all, whereas if total costs exceed total benefits, the policy is eliminated from consideration. The value that regulators are interested in is **net benefits**, which is defined as total benefits minus total costs. If this value is positive, the benefits exceed the costs, and the project or policy remains a possibility. If net benefits are negative, it means the policy is more costly than it is worth, and that policy is no longer considered.

When using BCA to choose among multiple policies or projects, the next step is to identify that policy for which net benefits are maximized; among the alternatives you considered the policy with the maximum net benefits is the one which will provide you with the greatest return.

It sounds like a reasonable procedure. But there are problems with the application of BCA:

1. How do you quantify the costs and benefits of programs that impact the environment? Most environmental amenities are un-priced, which is one reason they are suffering market exploitation in the first place. How then do you place a value on those amenities, and how valid are the numbers that you come up with?

2. When costs and benefits associated with projects or policies are spread out over time, how do you compare and aggregate them? How do you compare costs incurred today to the benefits that this generation or future generations stand to gain tomorrow, or next year, or 50 years from now? This is a particularly controversial issue when environmental projects are involved, because many times either the cost of the project (such as accidents associated with nuclear waste disposal), or the benefits (such as with efforts to slow global warming) may be felt very far into the future.

The first problem is termed **valuation** and we will deal with it in chapter 5. This is one of the major topics that determine if a project should be taken or not. When the value of all significant benefits and costs can be expressed in monetary terms, the net value (benefits minus costs) of the alternatives under consideration can be computed and used to identify the alternative that yields the greatest increase in public welfare. However, since environmental goods and services are not commonly bought or sold in the marketplace, it can be difficult to express the outputs of an environmental restoration plan or let alone state its value in monetary terms.

The tools associated with BCA and value estimation have been developed to evaluate the overall economic efficiency of proposed actions, but the efficient use of resources is only one of many important social goals. Equity and justice are two others. For this reason, traditional BCA or alternative tools for assessing efficiency should not be used without also considering such factors as distributional effects (who pays vs. who benefits) and environmental justice (disproportionate share of negative impacts born by low-income and minority populations). It should be noted that there is another school of thought which claims that any consideration of the goodness of the fit between who is paying for the project and who is benefiting from it must happen outside the framework of BCA. The distributional effects of publicly funded projects must be considered from the standpoints of equity and justice and not from the standpoint of efficiency.

Another important point to be considered is that it is possible that many of the supposed benefits would have occurred without public expenditures. Perhaps one of the most important and difficult components of BCA is the definition of the most likely future scenario without-project condition, which forms the baseline of comparing all the with-project alternatives. For example, let us examine a project to invest in cleaning a river that suffers from sewage pollution. We know that without investing in cleaning the river, it will reach some degree of natural rehabilitation. Therefore, the BCA analysis will be to examine "with-vs.-without" the project rather than "before-vs.-after" the project.

We return now to the second major problem mentioned above - benefits and costs realized at different times. Economists address this issue with a process called **discounting**.

### 4.3. Discounting

An economist will argue that a dollar received at some point in the future is not worth as much as a dollar received today. To illustrate that, consider the following decision: If somebody came up and offered you a choice between receiving 1000 dollars today and putting 1000 dollars in a trust fund that would give you 1000 dollars ten years from now, what would you do? Most rational people would take the money now. There are two reasons for that. One is that in general, people are impatient, and they would rather have things now than later. In economics this impatience is called "**a positive rate of time preference**" - it means we prefer good things now. The second reason is that even if you don't think you will need the money in ten years from now, there are things you can do with it now that will increase it's value over time. In particular, you could invest today's dollars and receive some sort of return so that tomorrow they are worth more than they are today.

How much would your $1000 be worth in ten years if you invested them and received a return on it?

That conversion (the future value of today's dollars) is calculated using a compounding formula: Future Value (at time T) = (present value)*(1+r)T

Where r refers to the rate at which your money is growing over time; if we are using the example of money growing in a savings account, for instance, r would be the interest rate received on the account. So if you invested your $1000 in an account earning %5 interests per year, in ten years, your money would be worth:

$1000(1+.05)$^{10}$= $1628.29.

If instead you chose to invest in the stock market, and you hit on a good stock with a steady 10% return per year for 10 years, at the end of those 10 years, your $1000 would be worth $1000(1+.10)$^{10}$= $2593.74.

So this tells us, what is today's $1000 worth 10 years in the future, given that it could increase in value if we put it to some productive use.

The reverse question is, what would the $1000 that we might have received in ten years be worth now? Well, it is essentially worth however much money you would have to have in your hand today in order to have it grow and be equal to $1000 in ten years. In other words, what amount of seed money do we need now in order to have it grow into $1000 ten years from now? To calculate that figure, we use a **present value** formula, which is the inversion of the compounding formula:

$$\textit{Present value} = \frac{\textit{Future Value (at time t)}}{(1+r)^t}$$

Calculating this number depends on r- the rate at which the money would grow if you had it today. This number is called a discount rate, and its value varies widely. One certain source of growth would be the interest mentioned on the savings account above, which is locked in when you make a deposit. Since we know that we can invest the money and earn 5% on it in a savings account, we will set the discount rate that we use to calculate present value equal to the interest rate that we could have earned on that account- 5%. At this discount rate, $1000 received ten years from now is worth much less than today:

$1000/(1.05)$^{10}$= $613.90.

What this formula tells us is that if I had $613.90 today, I could invest it in an account earning 5% interest, and what I would have in my account ten years from now (assuming I make no withdrawals) is exactly $1000. Theoretically, then, if I have no pressing need for the money right now, I should be indifferent between receiving $613.90 today and waiting ten years to receive $1000, because the two figures, using a discount rate of 5%, are worth exactly the same amount today. If somebody offered me $700 today or $1000 ten years from now, I should take the $700; if I invest it at 5% interest, in ten years it will be worth than the $1000 I could have chosen.

What does this have to do with Benefit-Cost analysis? Discounting is the same process that economists use to compare the costs and benefits that accrue to a project or policy over time.





They select a discount rate which is supposed to capture some measure of what dollars today are worth relative to dollars tomorrow, and then they convert all future costs and benefits into today's dollars in order to determine the advisability of a project with inter-temporal costs and benefits. The number that they are ultimately seeking is called the "**present value of net benefits**", and it is equal to the sum:

$$PV(NB) = \sum_{t=0}^{t=T} NB_t/(1+r)^t$$

So the first thing you have to do to come up with this value is to calculate the net benefits of the project in each time period (by subtracting total costs from total benefits). This will give you an estimate of $NB_t$ for each time period t.

The second step is to discount each of those net benefit figures from the future time period t back to the present. This will give you:

$$\frac{NB_t}{(1+r)^t}$$ for each time period.

The final step is to sum all of the discounted figures (one for each time period), which will give you:

$$PV(NB) = \sum_{t=0}^{t=T} NB_t/(1+r)^t$$

At that point, if PV(NB)>0, then you would conclude that the project is worth doing because its benefits over time exceed its costs over time. If PV(NB)<0, then the costs exceed the benefits, and you would not want to pursue that project. If you are using the present value analysis to compare the desirability of multiple projects, you would want to select that project for which the present value of net benefits is maximized.

**Example:**

Suppose you are considering a project of restoring a certain beach with the following schedule of expected costs and benefits associated with it over time:

| Time (Years) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Cost ($) | 30,000 | 0 | 0 | 0 | 0 | 0 |
| Benefit ($) | 0 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |

The first step is to calculate the net benefit associated with each time period:

| Time (Years) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Cost ($) | 30,000 | 0 | 0 | 0 | 0 | 0 |
| Benefit ($) | 0 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| Net Benefit ($) | -30,000 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |

The next step is to discount those net benefits back to the present. In this example we will use a discount rate of 6%:

| Time (Years) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Cost ($) | 30,000 | 0 | 0 | 0 | 0 | 0 |
| Benefit ($) | 0 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| Net Benefit ($) | -30,000 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| PV(NBt) | -30,000 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| | $1.06^0$ | $1.06^1$ | $1.06^2$ | $1.06^3$ | $1.06^4$ | $1.06^5$ |
| | -30,000 | 2,830 | 4,450 | 5,038 | 7,921 | 8,967 |

The last step is to sum all of these numbers to get an estimate of PV(NB). In this case the present value of net benefits associated with this project is -$794.00. Because this is a negative number, we would conclude that this is not a good project because its costs over time exceed its benefits.

To illustrate one of the problems with discounting as a method for comparing costs and benefits over time, repeat the analysis above using a discount rate of 3% rather than 6%. You should get the following results:

| Time (Years) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Cost ($) | 30,000 | 0 | 0 | 0 | 0 | 0 |
| Benefit ($) | 0 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| Net Benefit ($) | -30,000 | 3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| PV(NBt) | -30,000 | -3,000 | 5,000 | 6,000 | 10,000 | 12,000 |
| | $1.03^0$ | $1.03^1$ | $1.03^2$ | $1.03^3$ | $1.03^4$ | $1.03^5$ |
| | -30,000 | 2,913 | 4,713 | 5,491 | 8,885 | 10,351 |

Using the new discount rates, the PV(NB) = $2353. Since this is a positive number, we now find the project worthwhile, although none of the costs or benefits has changed. Only the discount rate changed, which changed the rate at which we devalued future costs and benefits in converting them to present values. So whether a policy is considered a good policy or not is highly dependent on the discount rate chosen, but how do you choose a discount rate? There is a great deal of debate about this question among economists and there is no consensus. There are, in general, three arguments concerning the question how a discount rate should be chosen.

1. One school of thought argues that the discount rate should reflect the alternative productivity of capital. The argument is that if the government is thinking about spending public resources on a project, the rate that is used for discounting should be equal to the opportunity cost of capital, or the return that could be expected if the dollars put toward that project were invested in the private sector instead. If the discount rate in an analysis is set equal to the return on capital in another use, then the PV(NB) will only be positive if the total benefits of the project exceed the total costs, and if the amount by which benefits exceed costs provides a return to the investment in costs that exceeds the return that investment could have earned in an alternative use.

2. The second school of thought argues that the discount rate should reflect society's "rate of time preference". According to this approach, we must figure out somehow how to measure the magnitude of "impatience" that people have for enjoyment of benefits now versus later. This is a very difficult task, as it is likely that every individual has a different rate, as do different cultures. Resources for the Future (Cropper et al. 1992) conducted a survey in which they asked individuals to choose between receiving $10,000 today and receiving larger amounts 5 or 10 years from now in an attempt to tease out what this inherent rate of impatience was. Their responses suggested that time preference-based discount rates were about 20% for a five-year horizon and 10% for a ten-year horizon; these figures would imply much higher discount rates than the ones suggested by the opportunity cost of capital approach.

3. The final school group argues that the discount rate used to evaluate public policies should reflect our judgment about how the well-being of different generations should be weighted. This philosophy reflects the fact that in selecting a discount rate, we are in effect choosing how we are going to balance our own generation's interests against those of the future. Because discounting results in such a rapid devaluation of future costs and benefits, even small discount rates of 3-5% mean that the costs that our actions impose on generations 200 years from now are given almost no weight in today's decision-making. This school argues that such an approach is unethical. The discount rates proposed by this group for far-future discounting are lower than the other schools of thought, and they can approach zero for projects with costs extending centuries into the future.

Some economists also argue that in part, due to the problems stemming from discounting, the procedures of benefit-cost analysis and discounting are simply inappropriate for application to projects whose costs and benefits extend centuries into the future.

## 4.4. Alternative Analytical Methods

Whenever it's not possible or desirable to monetize the benefits of the project alternatives that are being evaluated, as would be needed for BCA, there are other economic tools that can help resource managers incorporate cost considerations into decision-making. Two of the most commonly used tools are closely related to BCA-Cost-Effectiveness Analysis and Incremental Analysis.

Cost-Effectiveness Analysis (CEA) is used when there are two or more ways to achieve the same goal or to produce the same type and level of outputs. Given some environmental goal, such as enabling specified numbers and types of fish to pass a low dam, CEA helps users to identify the least-costly means of achieving that goal. When correctly applied, CEA takes into account the full stream of project costs, including construction, maintenance, and monitoring costs, as well as the time-value of money. Unlike BCA, CEA cannot be used to identify optimal plans when outcomes are dissimilar either in type or magnitude, but it does support the incorporation of cost considerations into decision-making.

Incremental Analysis (IA) is used primarily to evaluate alternatives that produce varying quantities of similar outputs. If, for example, the salinity of a wetland has been altered by a series of culverts and channel modifications, IA can be used to rank each increment of restoration (e.g., replacing culverts and restoring altered stream morphology) in terms of their cost-effectiveness. Like BCA and CEA, IA takes into account the full stream of project costs and the time value of money, and, like CEA, it does not require that the value of outputs

be monetized. Unlike CEA, it does require that the outputs be quantified. In the example above, analysts would need an estimate of the salinity change associated with each increment of improvement.

## 4.5. Risk and Uncertainty

Up until this point, we have assumed that benefits and costs are known with certainty. However, in reality this is not the case. The main reason is because when we deal with cost-benefit analysis, we usually deal with future values. Since the future is not certain, so are these values of benefits and costs. How can we take that into account in our economic analysis?

Our aim is to converge to a single number but to treat it as a point estimator. That is, a number which is the most likely outcome we should expect. However, we should not be surprised that the final outcome would turn out to be different than the one we have expected. One way of dealing with this uncertainty is to perform the analysis for a range of values. This is called sensitivity analysis. By doing that we may have a better knowledge of how changes in the realization of the values affect the final solution. For example, if a small change in the benefit value can turn a successful project to a loser, then we might be more careful in the first place when we have to decide whether to do it or not.

Another way of dealing with this uncertainty is to build interval blocks which may be stated qualitatively or quantitatively. In the first case it might be a statement such as: "we are highly confident that the outcome would be in the range between X and Y". In the second case it can be a statement such as: "There is 90% probability that the final outcome would be in the range between X and Y."

In the case of MPAs, we might think of two sources of uncertainty (there are others which depend on the specific study): Biological uncertainty and Economic uncertainty.

Biological uncertainty refers to situations in which we don't know how nature will behave. We don't know for sure how rehabilitation will affect wildlife in the area since wildlife might be affected by other factors besides rehabilitation and we can not separate them because there is no possibility to perform a controlled research.

Economic uncertainty refers to a situation in which some socio-demographic factors might change but we don't know exactly by how much. For instance, we might speculate that the demand for nature travels will increase in the future and we might even perform an ex-post study with past data. However, this still doesn't guarantee that what happened in the past will return in the future.

One way of dealing with these types of uncertainties is to have a list of scenarios, each with a probability of occurrence and its impact. The probabilities can be taken from past events or from experts' surveys. The impact is derived from the model itself.

The following table lists six scenarios, each with its probability and benefit impact.



Table 4.1: Decision under Uncertainty Conditions

| Scenario | Benefits ($) | Probability | Benefits x Probability ($) |
|---|---|---|---|
| A | 40 | 0.40 | 16 |
| B | 30 | 0.20 | 6 |
| C | 20 | 0.10 | 2 |
| D | 10 | 0.20 | 2 |
| E | 50 | 0.05 | 2.5 |
| F | 60 | 0.05 | 3 |
| | | 1.00 | 31.5 |

As can be seen from the table, the expected benefits are 31.5 and this is one possibility - treating the benefits as one number. However, there are other possibilities. Sometimes decision makers prefer to work with the most likelihood event. As can be seen from the table, the accurate number is 40, since this number appears in 4 out of 10 times which is the largest number of occurrences. Yet another criteria might be to take the lowest number as a precautionary step. By that method, 10 is the estimated benefit of the project.

A sensitivity analysis can be performed by analyzing the project with a sensitivity analysis of the three benefit estimates: 10, 31.5 and 40. If the answer is the same for all three numbers, the decision is simple. However, if the result of the CBA is very sensitive to the numbers, then a more thorough research might be accurate.

Dealing with biological uncertainty in the Great Lakes:

Bishop (1990) studied the costs and benefits of a possible fish rehabilitation project in part of the Great Lakes. The state of Wisconsin was planning to put restrictions on fishing the yellow perch in order to increase its stock. But there were many biological uncertainties so it was not clear to what extent fishing restrictions would help. Bishop was analyzing the situation by looking at six possible scenarios, each differing from the other by the assumptions of how fast and how far the fish stock would recover. The benefit from each scenario was calculated and then weighted by a probability of occurrence based on biological experts.

## 4.6. Distributional Issues and Equity

Up until now we talked only about efficiency. But efficiency doesn't mean the project is fair or equitable. Fairness has to do with how overall benefits and costs are distributed among different subgroups, or stakeholders, in the society. Suppose a local beach community is facing the dilemma whether to allocate part of a restored and unique beach for commercial purposes. This act would put in danger certain species which are endemic to the area. From the national economy standpoint, the commercial value of the restored beach has little significance, but from the community point of view it is very significant. What seems to be the efficient solution from a national perspective might be regarded as unfair from the local perspective.

The issue of distributional disconnection represents very much the MPAs conflict. The benefits of creating an MPA might be high in total but are spread widely among the general popu-

lation. On the other hand, costs may be lower than the benefits but are very significant on the local level. This is a major source of conflict between proponents and those who object development vs. those who prefer preservation. Three programs are listed in the following table. Each one has an impact on five groups of stakeholders:

Table 4.2: Distributional effects of three programs

| | | Groups | | | | |
|---|---|---|---|---|---|---|
| Program A | Total | I | II | III | IV | V |
| Benefits | 100 | 20 | 20 | 20 | 20 | 20 |
| Costs | 80 | 16 | 16 | 16 | 16 | 16 |
| Program B | | | | | | |
| Benefits | 100 | 20 | 20 | 20 | 20 | 20 |
| Costs | 80 | 40 | 10 | 10 | 10 | 10 |
| Program C | | | | | | |
| Benefits | 100 | 80 | 5 | 5 | 5 | 5 |
| Costs | 80 | 16 | 16 | 16 | 16 | 16 |

As can be seen from the table, all three programs have similar total benefits and costs. What is different among them is the distribution among the five stakeholder groups. There is an even distribution in program A, both with respect to benefits as well as costs. However, in program B, while benefits are evenly distributed, costs are concentrated within group I. The situation is reversed in program C. Here, costs are evenly distributed while benefits are concentrated within one group only.

Program A is presented only as a reference point. The problems start to appear in programs B and C. In program B, the net benefit to society is positive and so is the net benefit to four out of the five stakeholders. However, group I is severely damaged by the program. An example might be an MPA program that its main feature is to protect an endangered species. There is a net positive small benefit to people around the nation (probably most of it in the form of non-use value), while the only group who is affected is the local population who is restricted in their commercial activities. The situation is reversed in program C. Here we can see that while the net benefit to society is positive, the majority of the population loses from it. In a democratic society, where the majority rules the game, there appears to be a contradiction between efficiency and democracy. The benefits are centralized only by one group out of five. An example might be the restoration of a beach. Benefits are localized but disappear beyond the local area.

## 4.7. Summary

In this section we learned how to deal with evaluating public projects and programs. Managing MPAs and planning them has a lot to do with CBA. As we saw, the method deals with estimation of benefits and costs in a different way than the private sector does.

Time is an important factor in conducting CBA. Almost all programs and projects do not yield benefits and costs which are given at one point in time. We learned how to discount future values in order to get a common denominator for adding and subtracting the relevant numbers.





We learned how to deal with choosing among projects with a limited budget, when the projects are associated with risk and uncertainty and when we want to better understand the trade-off between net benefit estimation and equality.

Conducting CBA is essential for decision makers in order to get a more educated decision. It doesn't have to be the one who maximizes the net benefit but it gives decision makers a kind of a crystal ball in which they can better understand the consequences of their choices.
How do they get the benefit estimates when markets do not operate well and sometimes do not operate at all? We explain several methods in the next section.

## 4.8. Further Readings

1) Boardman, A. D. Greenberg, A. Vining and D. Wiemer. Cost Benefit Analysis: Concepts and Practice 3rd ed., Prentice Hall, 2005.
2) Campbel, H.F. and R.P.C. Brown. Benefit Cost Analysis: Financial and Economic Appraisal using spreadsheets. Cambridge University Press, 2003

Two recommended textbooks that deal with the topic. The first one puts more effort on theory and concepts while the second one deals more with applications.

3) Emerton Lucy (1999). Economic Tools for the Management of Marine Protected Areas in Eastern Africa. Biodiversity Economics for Eastern Africa. IUCN - The World Conservation Union.

This document deals with the relevance of Economics to MPAs. It relates to issues such as the economic benefits of MPAs and the role of economic tools in managing them.

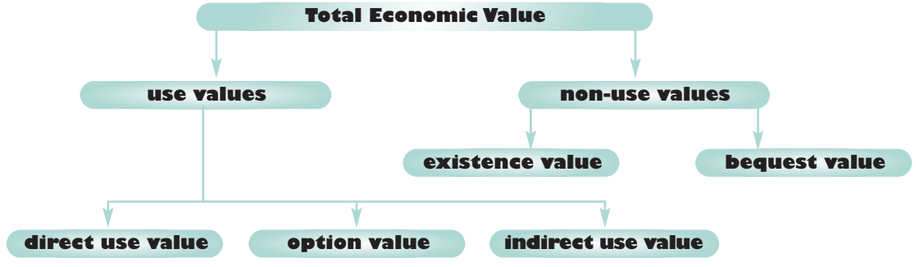
# 5. Valuation of Non-Market Benefits

## 5.1. Introduction

For many environmental resources including such amenities as clean air, parks and biological resources, visitors and other users don't have an option to purchase the exact amount of the resource they would like to obtain. Provision and maintenance of such resources is a matter of collective choice, generally made through regulation and legislation. Many environmental resources cannot be purchased in markets so there is no observed price which might signal how much is the resource valued by its users. Therefore, economists have developed a range of methods to measure the value of such goods, non-market good.

We follow the generally accepted typology presented in Mitchell and Carson (1989) for the different types of values which might be associated with environmental resources such as MPAs.

Figure 5.1: Classification of Values




- *Use-value:* this value can be further classified as direct or indirect. Direct use can be divided between resource use as an input to an economic activity (fishing, diving) or waste disposal (nutrient recycling). Indirect use (which is sometime called passive-use) has also two com-

ponents: aesthetic value (beach recreation) and ecosystem value (Bird watching - by eating fish and supporting the ocean food chain).
- *Existence value:* This is also divided to altruistic value (value of leaving an area intact for the general population) and bequest value (leaving an area preserved for future generations).
- *Option value:* The value of preserving an area in its natural format in order to have an option to use it in the future. Option value can be considered sometimes as use-value.

There are two methods of valuation: Indirect methods and direct methods. The first set of methods relies on a nearby operating market. The second relies on direct valuation by asking people about their willingness to pay. The major merit of indirect methods is that they are based on real behavior. This is also the major drawback of the direct method which is based on questionnaires. The major merit of the direct method is the fact that only in this method it is possible to estimate non use-values. This is because estimation is done by revealed methods rely only on use behavior. Therefore, if we are to believe that there is a large fraction of the value of the resource which is associated with non-use-values, then we might omit an important part if we are to rely only on indirect methods in our estimation procedure.

Estimation of non-market benefits has a crucial importance for governmental budget allocation. If the environmental services created by an MPA are larger than the costs associated with it, then this project should be carried out. Since these services consist of public goods, the government should provide them and do it from the general budget pool. Closing the area and charging entrance fees misses the point of open spaces. Sometimes it doesn't costs much to operate the MPA but the alternative costs are high (e.g., commercial development etc.). Here the budget allocation is not important but efficient land use management should be considered. That is, giving up "real" money from development for "virtual" monetary amount which can be derived by the methods that will be described below. Whatever the source of the sacrifice for these environmental services is: The general budget or alternative commercial development losses, these environmental services should be monetized in order to be sure we are making a rational decision by preferring preservation over development. In this section we will show different methods to estimate these values.

## 5.2. Indirect Method - The Travel Cost Method (TCM)

### Overview:

The travel cost method is mainly used to estimate economic use-values associated with ecosystems or sites that are used for recreation. This is especially important to MPAs in which the use-value consists of a large part of their value.

The method can be used to estimate the economic benefits or costs resulting from:

- The elimination or creation of an MPA.
- Changes in environmental quality at a given MPA.

The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site. Thus, peoples' willingness to pay to visit the site can be estimated based on the number of trips that they make at





different travel costs. This is analogous to estimating peoples' willingness to pay for a marketed good based on the quantity demanded at different prices.

For example, a site used mainly for recreational fishing is threatened by development in the surrounding area. Pollution and other impacts from this development could destroy the fish habitat at the site, resulting in a serious decline or total loss of the site's ability to provide recreational fishing services. The goal is to determine the value of programs or actions to protect fish habitat at the site.

The travel cost method fits well in this case for two main reasons:

1. The site is primarily valuable to people as a recreational site and there are no significant non-use-values associated with it.
2. The expenditures for projects to protect the site are relatively low. Thus, using a relatively inexpensive method like travel cost makes the most sense.

### Options for Applying the Travel Cost Method:

There are several ways to approach the travel cost method.

These include:

1. A zonal travel cost approach, using mostly secondary data (taken from external resources like the central bureau of statistics etc.) with some simple data collected from visitors.
2. An individual travel cost approach, using a more detailed survey of visitors.
3. A random utility approach using surveys and other data, and more complicated statistical techniques.

### Application of the Zonal Travel Cost Method (ZTCM):

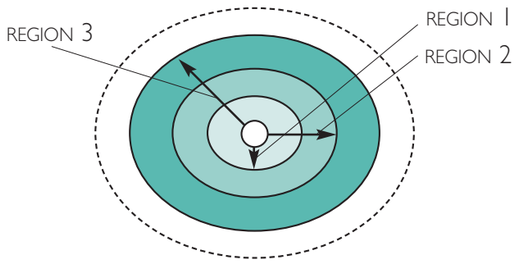
The **zonal travel cost method** is the simplest and least expensive approach. It will estimate a value for recreational services of the site as a whole. It cannot easily be used to value a change in quality of recreation for a site, and may not consider some of the factors that may be important determinants of value.

The zonal travel cost method is applied by collecting information on the number of visits to the site from different distances. Because the travel and time costs will increase with distance, this information allows the researcher to calculate the number of visits "purchased" at different "prices." This information is used to construct the **demand function** for the site, and estimate the **consumer surplus**, or economic benefits, for the recreational services of the site. Below we provide a cook book step by step explanation of the approach:

### Step 1:

The first step is to define a set of zones surrounding the site. These may be defined by concentric circles around the site, or by geographic divisions that make sense, such as metropolitan areas or counties surrounding the site at different distances.

Figure 5.2: Sketching Concentric Zones in TCM




### Step 2:

The second step is to collect information on the number of visitors from each zone, and the number of visits made in the last year or years or an average of number of visitors over the years. The best thing to have is a recorded list from the staff at the site of the zip codes where visitors came from. However, personal interview with a sample of the visitors might prove more efficient since one can get an estimate of other factors affecting the visit such as income, education etc. Personal interviews can reveal also other sites visited at that trip which affects the value of the site.

### Step 3:

The third step is to calculate the visitation rates per 1000 population in each zone. This is simply the total visits per year from the zone, divided by the zone's population in thousands. Please note that all you have is the visitation rate from the sample. In order to get visitation rate from the general population, it is assumed that the distribution in the sample is exactly the same as the distribution in the general population with respect to visitation rates. In addition, we need to know the total number of visitors to the site. The calculation thereafter is straightforward (table 5.1)

Table 5.1: Opening Table for ZTCM

| Zone | Total Visits/Year | Zone Population | Visits/1000 |
|---|---|---|---|
| 0 | 400 | 1000 | 400 |
| 1 | 400 | 2000 | 200 |
| 2 | 400 | 4000 | 100 |
| 3 | 400 | 8000 | 50 |
| Beyond 3 | 0 | | |
| | | | |
| Total Visits | 1600 | | |



### Step 4:

The fourth step is to calculate the average round-trip travel distance and travel time to the site for each zone. Assume that people in Zone 0 have zero travel distance and time. Each other zone will have an increasing travel time and distance. Next, using average cost per km and per hour of travel time, it is straightforward to calculate the travel cost per trip. A standard cost per km for operating an automobile is readily available from many sources. Assume that this cost per km is $.30. Assume that it is $9/hour, or $0.15/minute for all zones, although in practice it is likely to differ by zone (table 5.2).

Table 5.2: First Step Calculation for ZTCM

| Zone | Round Trip Travel Distance | Round Trip Travel Time | Distance times Cost/km ($0.30) | Travel Time times Cost/Minute ($0.15) | Total Travel Cost/Trip |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 20 | 30 | $6.00 | $4.50 | $10.50 |
| 2 | 40 | 60 | $12.00 | $9.00 | $21.00 |
| 3 | 60 | 90 | $18.00 | $13.50 | $31.50 |

In order to trace the demand function we need now to simulate how increase in the entrance price would effect visitation. Unfortunately, we do not have entrance fee so we use the data we gathered on travel cost and visitation. We do that in two ways: A non-functional form (step 5a) and a functional form (step 5b).

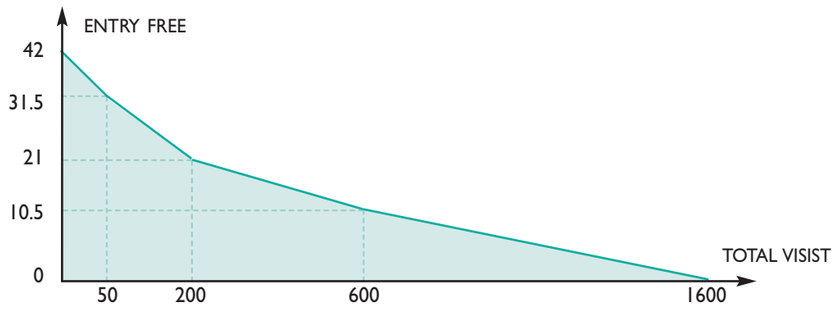
### Step 5a:

First note that when the entrance fee is zero, there are a total of 1600 visits to the site. Now suppose we raise the price to $10.50. What will happen? Let's consider first the visitors from zone 0. Their travel costs are zero but their total trip costs now are composed of travel AND entrance fee totaling to $10.5. In order to know how this price change affected their visitation rate, it is helpful to note that their cost NOW is exactly the same as the cost to visitors originated in zone 1 BEFORE the price increase. Therefore, we can deduce that their behavior now would be the same as visitors from that zone. Looking at table 5.1 we can see that the visitation rate for zone 1 visitors is 0.2 (relative to visitation rate for visitors from region 0 which was 0.4). Knowing that the population in zone 0 is 1000 we know that when the price is $10.5 there would be 200 visitors originating from zone 0. The same type of calculation holds for visitors from zone 1. When there is an entrance fee of $10.5 their total visit cost would be $21 (equals $10.5 travel cost + $10.5 entrance fee). From table 2 we see that this is exactly the travel cost faced by visitors in zone 2 when the entrance fee was 0. Therefore, we can expect that the visitation rate would be 0.1 for visitors in zone 1 (the rate which applied to visitors in zone 2 before the price increase). That means 200 visitors from zone 1 (since the population there is 2000). Exactly the same calculation holds for visitors from zone 2. Their visitation rate would go down to 0.05 which means a contribution of 200 visitors from that zone. Finally, visitors from zone 3 would not come since their new trip cost would put

them in a position as visitors from zone 4 which was assumed to be zero in the first place. By summing up all the visitors with entrance fee we find that there would be only 600 visitors instead of 1600.

As an exercise, convince yourself that when we increase the entrance fee again by $10.5 (to a total of $21) there would be only 200 visitors (visitors from zone 2 would behave as visitors from zone 2 and visitors from zone 1 like those from zone 3). Another increase of the entrance fee to $31.5 would reduce the number of visits down to 50 and one more price increase to $42 would chalk off the demand entirely. These iterations are summarized in figure 5.3. The total benefit of the site is the area under the demand curve which can be found simply by calculating rectangles and triangles. The total area is equal to 15,225 and this can be considered as the value of the site. $?

Figure 5.3: Calculating the Value of the Site in the Zonal TCM - Non Functional Approach




Step 5b:

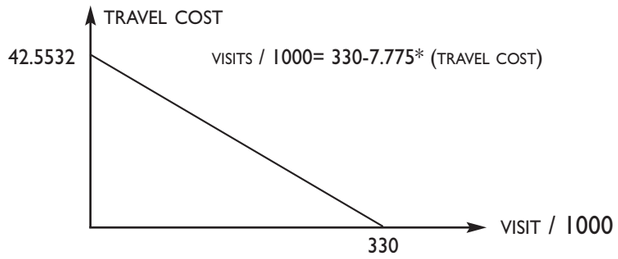
We can repeat the analysis by using **regression analysis** (see appendix to this chapter). This is done by finding the equation that relates visits per capita to travel costs and other relevant variables. From this it is possible to estimate the demand function for the average visitor. In this model, the analysis might include demographic variables, such as age, income, gender, and education levels, using the average values for each zone. To maintain the simplest possible model, we calculate the equation with only the travel cost:

visits/1000, Visits/1000 = 330 - 7.755*(Travel Cost)

This is shown in figure 5.4



Figure 5.4: Visit Frequency Graph




Step 6:

The sixth step is to construct the demand function for visits to the site, using the results of the regression analysis. The first point on the demand curve is the total visitors to the site at current access costs (assuming there is no entry fee for the site), which in this example is 1600 visits per year. The other points are found by estimating the number of visitors with different hypothetical entrance fees (assuming that an entrance fee is viewed in the same way as travel costs).

For the purposes of our example, start by assuming a $10 entrance fee. Plugging this into the estimated regression equation, V = 330 - 7.755C, gives the following (table 5.3):

Table 5.3: Second Step - Constructing the Demand Function

| Zone | Travel Cost plus $10 | Visits/1000 | Population | Total Visits |
|---|---|---|---|---|
| 0 | $ 10.00 | 252 | 1000 | 252 |
| 1 | $ 20.50 | 171 | 2000 | 342 |
| 2 | $ 31.00 | 90 | 4000 | 360 |
| 3 | $ 42.50 | 0 | 8000 | 0 |
| Total Visits | | | | **954** |

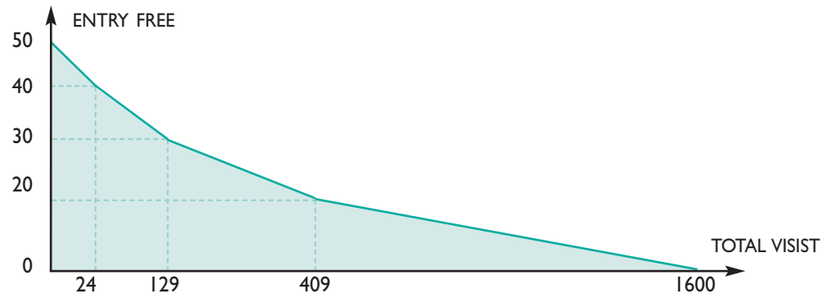
This gives the second point on the demand curve-954 visits at an entry fee of $10. In the same way, the number of visits for increasing entry fees can be calculated, to get table 5.4:

Table 5.4: Tracing the Entire Demand Path

| Entry Fee | Total Visits |
|---|---|
| 0 | 1600 |
| 20 | 409 |
| 30 | 129 |
| 40 | 20 |
| 50 | 0 |

These points give the demand curve for trips to the site which is shown in figure 5.5.

Figure 5.5: Calculating the Value of the Site in the Zonal TCM - Non Functional Approach




Step 7:

The final step is to estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve. This results in a total estimate of economic benefits from recreational uses of the site in our example of around $23,000 per year, or around $14.38 per visit ($23,000/1,600).

## How Do We Use the Results?

Remember that the main goal of using TCM in this example was to decide whether it is worthwhile to spend money on programs and actions to protect this site. If the actions cost less than $23,000 per year, the cost will be less than the benefits provided by the site, as seen by the public. If the costs are greater than this, researchers and decision makers will have to decide whether other factors make them worthwhile.

### Application of the Individual Travel Cost Approach (ITCM):

The individual travel cost approach is similar to the zonal approach, but uses survey data from individual visitors in the statistical analysis, rather than data from each zone. This method thus requires more data collecting and slightly more complicated analysis, but will give more precise results.

For the hypothetical example of the recreational fishing site, rather than collecting information on number of visitors and their zip codes (like is usually done in the zonal TCM), the researcher should conduct a survey of visitors. The survey might ask for the following information:

- location of the visitor's home - how far they traveled to the site
- how many times they visited the site in the past year or season
- the length of the trip
- the amount of time spent at the site
- travel expenses
- the person's income or other information on the value of their time
- other socioeconomic characteristics of the visitor





- other locations visited during the same trip, and amount of time spent at each
- perceptions of environmental quality or quality of the site

Using the survey data, the researcher can continue in a similar way to the zonal model, by estimating, using regression analysis, the relationship between the number of visits and travel costs and other relevant variables. This time, the researcher would use individual data, rather than data for each zone. The regression equation gives us the demand function for the "average" visitor to the site, and the area below this demand curve gives the average consumer surplus. This is multiplied by the total relevant population (the population in the region where visitors come from) to estimate the total consumer surplus for the site.

Because additional data about visitors, substitute sites and quality of the site has been collected, the value estimates can be "fine tuned" by adding these other factors to the statistical model. Including information about the quality of the site allows the researcher to estimate the change in value of the site if its quality changes. To do so, two different demand curves would be estimated, one for each level of quality. The area between these two curves is the estimate of the change in consumer surplus when quality changes.

In the above example, the researcher might recognize that development around the site is unlikely to totally destroy the quality of the site. However, it could diminish the population enough to adversely affect catch rates. By including catch rates in the model, the researcher can estimate the lost recreational benefits from reduced catch rates.

### Application of the Random Utility Approach:

The random utility approach is the most complicated and expensive of the travel cost approaches. It is also the "state of the art" approach, because it allows much more flexibility in calculating benefits. It is the best approach to use to estimate benefits for specific characteristics, or quality changes, of sites, rather than for the site as a whole. It is also the most appropriate approach when there are many substitute sites.

In the analysis the researcher might want to value the economic losses from a decrease in value of a specific attribute of the site rather than from loss of the entire site. The random utility approach would be the best way to do so, because it focuses on choices among alternative sites, which have different quality characteristics.

The random utility approach assumes that individuals will pick the site that they prefer, out of all possible fishing sites. Individuals make tradeoffs between site quality and the price of travel to the site. Hence, this model requires information on all possible sites that a visitor might select their quality characteristics, and the travel costs to each site.

The researcher might conduct a telephone survey of randomly selected residents. The survey would ask them if they go camping or not. If they do, it would then ask a series of questions about how many trips they took over the last year (or season), where they went, the distance to each site, and other information similar to the information collected in our individual travel cost survey. The survey might also ask questions about preferences on each trip, and how they were accomplished on an ordinal scale.

Using this information, the researcher can estimate a statistical model that can predict both the choice to go fishing or not, and the factors that determine which site is selected. If quality characteristics of sites are included, the model can easily estimate values for changes in site quality, for example the economic losses caused by a decrease in catch rates at the site.

More complicated, and thorough, applications may also collect information about:

- exact distance that each individual traveled to the site
- exact travel expenses
- the length of the trip
- the amount of time spent at the site
- other locations visited during the same trip, amount of time spent at each substitute sites that the person might visit instead of this one, and the travel distances to each site
- other reasons for the trip
- quality of the recreational experience at the site, and at other similar sites
- perceptions of environmental quality at the site
- characteristics of the site and other, substitute, sites

The most controversial aspects of the travel cost method include accounting for the opportunity cost of travel time, how to handle multi-purpose and multi-destination trips, and the fact that travel time might not be a cost to some people, but might be part of the recreational experience.

Advantages of the Travel Cost Method:

- The travel cost method closely mimics the more conventional empirical techniques used by economists to estimate economic values based on market prices.
- The method is based on actual behavior - what people actually do - rather than stated willingness to pay, what people say they would do in a hypothetical situation.
- The method is relatively inexpensive to apply.
- On-site surveys provide opportunities for large sample sizes, as visitors tend to be interested in participating.

Limitations of the Travel Cost Method:

- The travel cost method assumes that people perceive and respond to changes in travel costs the same way that they would respond to changes in admission price, which may not always be the case.
- The simplest models assume that individuals take a trip for a single purpose - to visit a specific recreational site. Thus, if a trip has more than one purpose, the value of the site may be overestimated. It can be difficult to apportion the travel costs among the various purposes.
- Defining and measuring the opportunity cost of time, or the value of time spent traveling, can be problematic. Because the time spent traveling could have been used in other ways, it has an "opportunity cost." This should be added to the travel cost, or the value of the site will be underestimated. However, there is no strong consensus on the appropriate measure - the person's wage rate, or some fraction of the wage rate - and the value chosen can have a large effect on benefit estimates. In addition, if people enjoy the travel itself, then travel time becomes a benefit, not a cost, and the value of the site will be overestimated.



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

- The availability of substitute sites will affect values. For example, if two people travel the same distance, they are assumed to have the same value. However, if one person has several substitutes available but travels to this site because it is preferred, this person's value is actually higher. Some of the more complicated models account for the availability of substitutes.
- Those who value certain sites may choose to live nearby. If this is the case, they will have low travel costs, but high values for the site that are not captured by the method.
- Interviewing visitors on site can introduce sampling biases to the analysis.
- Measuring recreational quality and relating them to environmental quality can be difficult.
- Standard travel cost approaches provides information about current conditions, but not about gains or losses from anticipated changes in resource conditions.
- In order to estimate the demand function, there needs to be enough difference between distances traveled to affect travel costs and for differences in travel costs to affect the number of trips made. Thus, it is not well suited for sites near major population centers where many visitations may be from "origin zones" that are quite close to one another.
- The travel cost method is limited in its scope of application because it requires user participation. It cannot be used to assign values to on-site environmental features and functions that users of the site do not find valuable. It cannot be used to value off-site values supported by the site such as. Most importantly, it cannot be used to measure non-use values Thus, sites that have unique qualities that are valued by non-users will be undervalued.
- As in all statistical methods, certain statistical problems can affect the results. These include choice of the functional form used to estimate the demand curve, choice of the estimating method, and choice of variables included in the model.

## 5.3. Direct Method - The Contingent Valuation Method (CVM)

The contingent valuation method (**CVM**) is used to estimate economic values for all kinds of ecosystem and environmental services, MPA included. It can be used to estimate both **use** and **non-use values**, and it is the most widely used method for estimating non-use values. It is also the most controversial of the non-market valuation methods.

The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services. In some cases, people are asked for the amount of compensation they would be willing to accept to give up specific environmental services. It is called "contingent" valuation, because people are asked to state their willingness to pay, contingent to a specific hypothetical scenario and description of the environmental service.

The contingent valuation method is referred to as a "stated preference" method, because it asks people to directly state their values, rather than inferring values from actual choices, as the "revealed preference" methods do (like TCM). The fact that CV is based on what people say they would do, as opposed to what people are observed to do, is the source of its greatest strengths and its greatest weaknesses.

Contingent valuation is one of the only ways to assign dollar values to non use values of the MPA-values that do not involve market purchases and may not involve direct participation. These values are sometimes referred to as "passive use" values. They include everything from the basic life support functions associated with the reserve, to the enjoyment of its scenery

or the right to bequest those options to your grandchildren. It also includes the value people place on simply knowing that some endangered specie such as whales exist.

It is clear that people are willing to pay for non-use, or passive use, environmental benefits. However, these benefits are likely to be implicitly treated as zero value unless their dollar value is somehow estimated. So, how much are they worth? Since people do not reveal their willingness to pay for them through their purchases or by their behavior, the only option for estimating a value is by asking them questions.

However, the fact that the contingent valuation method is based on asking people questions, as opposed to observing their actual behavior, is the source of enormous controversy. The conceptual, empirical, and practical problems associated with developing dollar estimates of economic value on the basis of how people respond to hypothetical questions about hypothetical market situations are debated constantly in the economics literature. CV researchers are attempting to address these problems.

## Application of the Contingent Valuation Method:

### Step 1: Defining the valuation problem:

The first step is to define the valuation problem. This would include determining exactly what services are being valued, and who the relevant population is. In MPA the resource to be valued is the site itself and the services it provides - primarily wildlife habitat and scenery. Interested population can vary according to the case study from local to national and even international publics.

### Step 2: Determining the type of survey:

The second step is to make preliminary decisions about the survey itself, including whether it will be conducted by mail, telephone or in person, how large the sample size will be and who will be surveyed. The answers will depend, among other things, on the importance of the valuation issue, the complexity of the question being asked and the size of the budget.

In-person interviews are generally the most effective for complex questions, because it is often easier to explain the required background information to respondents in person, and people are more likely to complete a long survey when they are interviewed face to face. In some cases, visual aids such as videos or color photographs may be presented to help respondents understand the conditions of the scenario that they are being asked to value.

In-person interviews are generally the most expensive type of survey, though. However, mail surveys that follow procedures that aim to obtain high response rates can also be quite expensive. Mail and telephone surveys must be kept fairly short, or response rates are likely to drop dramatically. Telephone surveys may be less expensive, but it is often difficult to ask contingent valuation questions over the telephone, because of the amount of background information required.





### Step 3: Designing the survey:

The next step is the actual survey design. This is the most important and difficult part of the process, and may take six months or more to complete. It is accomplished in several steps. The survey design process usually starts with initial interviews and/or focus groups with the types of people who will be receiving the final survey, in this case the general public. In the initial focus groups, the researchers would ask general questions, including questions about peoples' understanding of the issues related to the site, whether they are familiar with the site and its wildlife, whether and how they value this site and the habitat services it provides.

In later focus groups, the questions would get more detailed and specific, to help develop specific questions for the survey, as well as decide what kind of background information is needed and how to present it. For example, people might need information on the location and characteristics of the site, the uniqueness of species that have important habitat there, and whether there are any substitute sites that provide similar habitat. The researchers would also want to learn about peoples' knowledge of the potential conflict between development and preservation. If people are opposed to development, they may answer the valuation questions with this in mind, rather than expressing their value for the services of the site. At this stage, different approaches to the valuation question and different payment mechanisms would be tested. Questions that can identify any "protest" bids or other answers that do not reveal peoples' values for the services of interest would also be developed and tested at this stage.

After a number of focus groups have been conducted, and the researchers have reached a point where they have an idea of how to provide background information, describe the hypothetical scenario, and ask the valuation question, they will start pre-testing the survey. This process continues until the researchers feel that the people understand the survey and answer accordingly.

The survey is actually a questionnaire that has three parts:

The first part is the scenario which must be explained in details, yet not to be too long since people tend to get tired reading, especially if they are in a recreation site. The scenario sets the framework of the hypothetical market which the respondents are asked to value.

The second part is the Willingness to pay question. In this part, the natural resource that is being evaluated is presented to the respondents as a commodity in the hypothetical market that was described earlier. The value the respondent places for this resource is reflected in his declaration of his alleged willingness to pay to preserve it or improved it. It is important to state the payment vehicle and to give thorough thought to its nature. People tend to cooperate with payment vehicles that are relevant to the matter - such as a rise in their water bill to improve drinking water quality - and to less cooperate when it is a general payment vehicle such as a fund. By using a "good" payment vehicle, the researchers will get more cooperation form the respondents.

There are a few ways of asking the willingness question. It is up to the researchers to decide which WTP question serves their goals the best way.

*Open-ended questions*: "What will be the highest amount you will be willing to pay per year through your municipality taxes, to improve the sanitation conditions of the local beach?" An open-ended question does not limit the respondent to a certain price and therefore doesn't suffer from an anchoring bias. The advantage of this type of question is that it gives the respondent's maximum WTP and it is fairly easy to analyze with simple statistic methods. However, an open-ended question is more likely to get protest answers, more zero answers and generally less answers. This may be because people are used to purchase goods according to their price and not according to their WTP for it. Another reason may be the fact that it is hard to state one's WTP for something they are not accustomed to buy.

*Bidding game*: "Would you be willing to pay a sum of 10$ per year through your municipality taxes, to improve the sanitation conditions of the local beach?" If the answer is "Yes", the bid goes higher until the respondent answers "No". This is their highest WTP. If the answer is "No", the bid goes down until the respondent answers "Yes". This too is their highest WTP. The assumption is that an iterative question makes it easier on the respondent to focus themselves on their true WTP. It suffers, though, form a starting-point bias, since the first sum that is presented to the respondent affects their answer. Another bias is the "warm-glow effect" that is associated with stating a higher bid than is truly intended.

*Payment card*: "Which of the following amounts reflect your highest WTP each year through your municipality taxes, to improve the sanitation conditions of the local beach?" This is the ladder approach - the respondent gets a range of amounts, from the lowest to the highest, and is asked to choose one of them. This method is based on the assumption that if the respondent is presented with a large range of numbers, it will be easier for them to choose the one that best reflects their choice. The bias in this method is the range itself.

*Single-bounded dichotomous choice*: "Would you be willing to pay a sum of 10$ per year through your municipality taxes, to improve the sanitation conditions of the local beach?" The respondent is asked to give the answer once. The amount varies randomly over the sample. This referendum method is based on the assumption that it would be easier for the respondent to answer since they are only being asked to agree or disagree to the price, pretty much they way the do while shopping at a supermarket. To use this method one needs a very large sample.

*Double-bounded dichotomous choice:* "Would you be willing to pay a sum of 10$ per year through your municipality taxes, to improve the sanitation conditions of the local beach?" If the answer is "Yes", the respondent is asked "would you be willing to pay 20$?" and if the answer in "No", the respondent is asked "would you be willing to pay 5$?" This is a more informative method since we can know the range of WTP if the respondent answered "Yes" to the first question and "No" to the second one. However, if they answered "Yes" or "No" to both, there is no way of knowing their WTP.

Hall et al. (2002) used a double bounded dichotomies choice type of a CVM questionnaire to estimate the value of coastlines in southern California intertidal zone especially close to urban areas. The problem facing these areas relate to insufficient funds that should be allocated to enforcement in order to prevent visitors from illegal collection and habitat disturbance. The respondents were chosen out of day visitors at sandy beaches in Orange County which means that the benefit value does not take into account all non-use values.
It was found that the mean WTP for increased enforcement was $6 per family visit. Taking into account the estimated number of visitors and dividing that by the length of affected beaches, Hall et al. found that the value per 1 mile of coast is between $3.6 to $4.8 million. This estimate can be taken into consideration in two ways during the decision making process. Firstly, it can be compared with the enforcement cost per 1 mile of coasts. If it is so, spending on enforcement is justified on Cost Benefit ground. Secondly, it can be compared with other areas and needs where spending is also required. Then the different projects should be ranked by their net benefit where the one having the highest net benefit should be financed first and so on.
Studies that incorporate visitors WTP can also enhance pricing policy as will be shown in chapter 6. However, in this case, closing the area is not a reasonable option so it was not considered.
Appendix 5.2 describes the survey Hall et al. used with some additional remarks added by us.

Which ever method the researchers choose, they must consider their budget limitations.
In this part respondents are also asked to choose an explaining sentence to the reason they chose this amount. Analyzing the answers can give an idea of use-values and non-use values people have for the site in question.

The third and last part is a set of socio-economic questions which help the researchers determine how they affect the respondent's WTP.

An example to the various ways one can phrase the WTP question is given in the appendix to this chapter.

### Step 4: Choosing the sample:

The next step is the actual survey implementation. The first task is to select the survey sample. Ideally, the sample should be a randomly selected sample of the relevant population, using standard statistical sampling methods. In the case of a mail survey, the researchers must obtain a mailing list of randomly sampled national population. They would then use a standard repeat-mailing and reminder method, in order to get the greatest possible response rate for the survey. Telephone surveys are carried out in a similar way, with a certain number of calls to try to reach the selected respondents. In-person surveys may be conducted with random samples of respondents, or may use "convenience" samples - asking people in public places to fill out the survey.

### Step 5: Analyzing the results:

The final step is to compile, analyze and report the results. The data must be entered and analyzed using statistical techniques appropriate for the type of question. In the data analysis, the researchers also attempt to identify any responses that may not express the respondent's value for the services of the site. In addition, they can deal with possible non-response bias in a number of ways. The most conservative way is to assume that those who did not respond have zero value.

## How Do We Use the Results?

From the analysis, the researchers can estimate the average and median values for an individual or household in the sample, and extrapolate this to the relevant population in order to calculate the total benefits from the site.

A few words of caution should be spelled out. When one extrapolates on a representative number, there are two points to think about: (1) The number of people that we consider as the correct number for extrapolation (2) The question of mean vs. median.

We would like to think that all projects are paid only by people who enjoy them. However, this is problematic since most of the times the nature of the good doesn't provide us with this option. We are dealing with public goods that a substantial component of their value is derived from the non-use benefit of the resource. Secondly, there might be a non negligible part of the value which accrues to people out of the country. These two types of people have a standing but they can't be forced to pay. Not treating them as part of the beneficiaries might create a misallocation of resources but would be fairer. This is a trade-off we can't resolve from an economic perspective. It is a political and social issue.

Should we use the mean value of the relevant population or the median? From a purely theoretical point of view, we should use the mean value. This gives us the true value of the benefit. However, there are two problems with this idea. First, mean values are subjected to extreme points. The median is not. Therefore, it might rule out manipulative answers to both sides. Secondly, in a democratic society, the decision is done by the majority. By using the majority's decision we automatically rule out how much an individual benefits or is damaged from the program but it nevertheless counts them in the same weight. There is a conflict that might arise here between democracy and efficiency.

Advantages of the Contingent Valuation Method:

- Contingent valuation is enormously flexible in that it can be used to estimate the economic value of virtually anything. However, it is best able to estimate values for goods and services that are easily identified and understood by users and that are consumed in discrete units (e.g., user days of recreation), even if there is no observable behavior available to deduce values through other means.
- CV is the most widely accepted method for estimating **total economic value**, including all types of **non-use**, **or "passive use," values**. CV can estimate use-values, as well as **existence values, option values**, and **bequest values**.
- Though the technique requires competent survey analysts to achieve defensible estimates, the nature of CV studies and the results of CV studies are not difficult to analyze and describe. Dollar values can be presented in terms of a mean or median value per capita or per household, or as an aggregate value for the affected population.
- CV has been widely used, and a great deal of research is being conducted to improve the methodology, make results more valid and reliable, and better understand its strengths and limitations.



## Limitations of the Contingent Valuation Method:

Although the contingent valuation method has been widely used for the past two decades, there is considerable controversy over whether it adequately measures people's willingness to pay for environmental quality. In what follows we take some of these critics and try to answer how to overcome the difficulties posed by these points.

- **Problem:** People have practice making choices with market goods, so their purchasing decisions in markets are likely to reflect their true willingness to pay. CV assumes that people understand the good in question and will reveal their preferences in the contingent market just as they would in a real market. However, most people are unfamiliar with placing dollar values on environmental goods and services. Therefore, they may not have an adequate basis for stating their true value.

  **Answer:** Surveys should be in a closed format which is easier for people to understand. Furthermore, surveys should go through a focus group stage in which people comment on unfamiliar sections in the survey. Finally, it is highly recommended to have a pilot stage in which 50 - 100 surveys have been analyzed prior to the actual study so that the researchers could deal with problems in the actual design of the survey.

- **Problem:** The expressed answers to a willingness to pay question in a contingent valuation format may be biased because the respondent is actually answering a different question than the surveyor had intended, hoping he or she could promote another environmental issue that could benefit from the results. Rather than expressing value for the good, the respondent might actually be expressing his feelings about the scenario or the valuation exercise itself. For example, respondents may express a positive willingness to pay because they feel good about the act of giving for a social good (referred to as the "warm glow" effect) although they believe that the good itself is unimportant. Respondents may state a positive willingness to pay in order to signal that they place importance on improved environmental quality in general. Alternatively, some respondents may value the good, but state that they are not willing to pay for it, because they are protesting some aspect of the scenario, such as increased taxes or the means of providing the good.

**Answer:** General WTP rather than WTP for a specific policy should be dealt with by clarification sentence after the WTP declaration, emphasizing the fact that the respondent can change his answer if his amount was general and not for the specific policy. Another option is to have the sample divided into several formats in which they differ by the amount of the ecosystem improvement. Using a T test can measure if there is a significant difference among the different formats. Dealing with zero response should be done again by a follow up question. The respondent should circle the reason for providing a zero WTP answer. If the reason is the unimportance this individual attach to the proposed policy, than the zero response is legitimate. If however it was found out that his response was actually a protest response than this person should be omitted from the sample. A protest response appears when the person believes the issue itself is important but it is not his responsibility to pay for it. Indeed there are people that might prefer living in a degraded environment rather to pay one more euro in the form of additional taxes. This type of preferences is like "cutting off

your nose to spite your face". It does not serve the purpose of measuring the benefit of the policy through a stated WTP and therefore this observation should be dropped out.

- **Problem:** Respondents may make associations among environmental goods that the researcher had not intended. For example, if asked for willingness to pay for improved visibility (through reduced pollution), the respondent may actually answer based on the health risks that he or she associates with polluted air.

  **Answer:** No other way but to phrase the relevant question in the clearest way possible, again by using focus groups as well as re-asking the respondent *after* he declared his WTP did he aim at what the survey intended and not any other purpose.

- **Problem:** Some researchers argue that there is a fundamental difference in the way that people make hypothetical decisions relative to the way they make actual decisions. For example, respondents may fail to take questions seriously because they will not actually be required to pay the stated amount. Responses may be unrealistically high if respondents believe they will not have to pay for the good or service and that their answer may influence the resulting supply of the good. Conversely, responses may be unrealistically low if respondents believe they will have to pay.

  **Answer:** While this might pose a problem of strategic manipulation, research and surveys have shown that the problem can be minimized by closed payment format, emphasizing the fact that there are other goals - private and public - that the budget of this individual might be allocated too and on the other hand, if not enough revenues would be collected then the policy would not be carried away.

- **Problem:** The payment question can either be phrased as the conventional 'What are you willing to pay (WTP) to receive this environmental asset?', or in the less usual form, 'what are you willing to accept (WTA) in compensation for giving up this environmental asset?' In theory, the results should be very close. However, when the two formats have been compared, WTA very significantly exceeds WTP. Critics have claimed that this result invalidates the CVM approach, showing responses to be expressions of what individuals would like to have happen rather than true valuations.

  **Answer:** At present there are almost no research carried out using WTA questions. However, we must keep in mind that if the true value is somewhere between the two formats, then our WTP estimate is a lower bound to the true value.

- **Problem:** If people are first asked for their willingness to pay for one part of an environmental asset (e.g. one lake / shore in an entire system of lakes / shores) and then asked to value the whole asset (e.g. the whole lake system), the amounts stated may be similar. This is referred to as the "embedding effect."

  **Answer:** Emphasizing the relevant policy and re-asking the respondent again might minimize the problem. Also, constructing different versions of the survey in which people are asked to pay for different intensity of the policy and check if the answers differ significant might solve the problem.



- **Problem:** Respondents may give different willingness to pay amounts, depending on the specific payment vehicle chosen. For example, some payment vehicles, such as taxes, may lead to protest responses from people who do not want increased taxes. Others, such as a contribution or donation, may lead people to answer in terms of how much they think their "fair share" contribution is, rather than expressing their actual value for the good.

  **Answer:** Focus group plays an important role ex-ante. A follow up question as to the motivation of payment can reveal some information ex-post.

- **Problem:** Many early studies attempted to prompt respondents by suggesting a starting bid and then increasing or decreasing this bid based upon whether the respondent agreed or refused to pay such sum. However, it has been shown that the choice of starting bid affects respondents' final willingness to pay response.

  **Answer:** Constructing different versions of the survey might help. In each version there might be another starting point or some versions might start from the low number while other might start from the higher. Mean WTP should not be significantly different among the different versions. If this is proved by a T test there is no starting point problem. This should be also taken care during the focus group phase and the pilot stage.

- **Problem:** Non-response bias is a concern when sampling respondents, since individuals who do not respond are likely to have, on average, different values than individuals who do respond.

  **Answer:** Collecting descriptive statistics of the sample versus the general relevant population might reveal the magnitude of the problem. If there is a significant difference between the mean of say environmental awareness of the sample and the general population then it is in fact a source of a bias but it can be dealt with. The coefficient of the relevant variable can be used to assess the new WTP when we plug in the mean value of the general population rather than the sample one.

- **Problem:** Estimates of non-use values are difficult to validate externally.

  **Answer:** A complementary study that concentrates on use-values based on indirect methods can be compared with the use-value derived from the CVM analysis. If the values are close enough then there is a good reason to believe that the non-use part is good enough also.

- **Problem:** When conducted to the exacting standards of the profession, contingent valuation methods can be very expensive and time-consuming, because of the extensive pre-testing and survey work.

  **Answer:** No easy answer for that. If you believe that there is not much value associated to the non-use part of the resource, then you might want to use indirect methods. Alternatively, you may use some results from some Meta - analysis based on previous research done on the topic.

## 5.4. Case Studies

### Case study 1:
### Application of non-market valuation to Florida Keys Marine reserve management

Bhat (2003) tried to estimate the value of preserving the coral reefs in the Florida Keys. The quality of coral reefs is essential to sustain nature-based tourism to that area. The recently established Marine Reserves are expected to improve the reef environment, especially coral and fish diversity and abundance.

The main purpose of the empirical model of the study was to estimate the non-market value of the reef quality improvement that resulted from establishing Marine Reserves. Hence it is a post analysis (an analysis done after the project was done to test for its credibility).

This was done with a combined model of TCM and CVM, where visitors were asked about their visiting frequency as a result of the reef quality. Current visiting rate was determined from the TCM questionnaire; stated visiting rate was determined from the CVM questionnaires, where visitors were shown two stages of reef quality - the first being the current situation and the second the situation as a result of establishing Marine Reserves - and were asked how the improvement will affect their visiting rate.

The results indicated that an average visitor would undertake 43-80% number of trips more to the Florida Keys and experience a 69% increase in the use value per trip, as a result of the Marine Reserve induced reef quality improvement.

These results lead to several interesting questions. One of them is whether the recreational amenities of the Florida Keys can handle such increase in tourism activity; will the Keys' carrying capacity sustain such an increase in tourism? If not, some complementary steps should be taken such as visit permits that can be distributed on an auction system or on a first comes first serve base. If the authorities sell the permits they create a revenue mechanism whereas if the entrance is still free and is limited by another mechanism, the financing mechanism should come from the general taxpayers system.

The questionnaire used by Bhat is given in the appendix to this chapter.

### Case Study 2:
### How does Atrazine Affect Water Recreation?

Earnhart and Smith (2003) examined the effect of the pesticide Atrazine on water-based recreation at Lake Clinton, Kansas, USA. Atrazine may enhance recreational enjoyment by inhibiting the growth of nuisance algae and thus encourage greater recreation; but the presence of Atrazine in reservoirs may be detrimental to fish populations and hence, reduce recreational use. To quantify and compare these countervailing effects, the authors applied the travel cost method in combination with contingent behavior questions.

The survey included 245 residents of Lawrence, Kansas. They were asked about their recreational use of Clinton Lake and data was collected to calculate travel cost to the lake.



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

Respondents were also asked about the change in their chosen destination with various changes in water quality: some changes were described as a decrease in algae, some were described as in decrease in fish and some were described as a combination of the two effects of Atrazine.

The results showed that the average respondent had a 22$ trip cost to the lake and a visiting rate of 3 trips per year. An improvement in algae-related quality would lead to an average increase of 2.7 visits per year while a decline in fish related quality would trigger an average decrease of 0.5 visits per year. The combination of quality changes would lead to an average decrease of 0.6 visits per year.

The Mediterranean Sea can have the same kind of effect from other type of pesticides flowing into the water for agricultural land surrounding the shores. This study can be used to examine how to allocate resources when there are several alternatives to improve the MPA. The one that has the greatest net benefit should get the first priority etc.

### Case study 3 - A CVM Application
### The economic value of water quality in the Catawba River Basin, North Carolina, USA

Kramer and Eisen-Hecht (2002) used CVM to estimate the economic value of protecting water quality in Catawba River basin at its current level. The authors conducted 1085 telephone interviews randomly selected in 16 counties within the basin in North and South Carolina. Prior to the telephone interview, a mailed a short information booklet that described a water quality management plan and then asked, over the phone, if they would support that management plan. It was explained that the payment for the plan would be collected through an increase in their usual state income taxes.

Two-thirds of the respondents expressed a positive WTP which was translated into annual economic benefit of $139 per Catawba River basin average taxpayer and more than $75 million for all taxpayers in Catawba basin counties.

The survey also contained questions about the reason respondents might value the management plan. It was found that their WTP was a function of both use values (concern about the quality of drinking water) and non-use values (the knowledge that the waters in the basin were being protected, regardless of respondents' use of them).

The annual benefits from the CVM survey were used as part of a cost-benefit analysis of implementing the water management plan. The results showed a net present value of $95 million (340 million $ value of benefits versus 245 million $ value of costs), indicating that the benefits far outweighed the costs.

### Case Study 4 - A TCM Application
### Valuing Coral Reef Protection

Pendleton (1995) used a TCM model to estimate the benefit derived from protecting the coral reef in the Bonaire MPA.

The visit per capita visitation function was estimated to be:

$VpC = 7.25X10^{-2} - 3.73X10^{-5}(TC)$

By knowing the travel cost from each zone and the previous estimation of the total number of visitors to be about 20,000, Pendelton used the ZTCM discussed above and found the value of the site to be 19.184 Million $ per year.

Pendelton argues correctly that by measuring the value of the site by the gross tourist expenditure, one doesn't get the benefit from using the resource but rather the cost associated with it to the consumers. However, TCM gives a true estimate of the net benefit of the resource (consumer surplus).

In the Bonaire case study, Pendelton shows that which ever way one measures the costs, one gets higher benefits compared to costs. This, however, is only a private case and thus care should be taken as to how to measure the benefits accordingly.

The sample used the diving tourists and not all tourists.

## 5.5. Summary

The most challenging task in CBA is benefit estimation. Since MPAs usually have a significant part of their value not traded in the market, we need to use special techniques in order to estimate their value. In this chapter we introduced two very helpful methods: The Travel Cost method (TCM) and the Contingent Valuation Method (CVM).

The TCM relies on a proxy market of behavior. While people do not trade the benefit provided by the MPA, they put a weight on it indirectly by scarifying travel cost to get to the site. These are usually given in terms of fuel and alternative time by looking into differences in visitation rates of people from different locations, we can induce how visit price effect visitation. We can therefore trace the demand curve and calculate the area under it which is the benefit of the site.

Unfortunately, TCM deals only with travelers who reached the site. Sometimes, however, the site contains benefits that can be classified as non-use values. These values can not be captured by visitation because they accrue without having to visit the site. In order to deal with these kinds of benefits we use the CVM. The CVM can detect the full value of the site but its weakness is by being a hypothetical method. In the chapter we discussed several consistency tests in order to be on safer grounds when pointing out the total value of the site.

## 5.6. Further Readings and additional references

### Further readings

1) Arin Tijen and Kramer Randall A. (2002). Divers' willingness to pay to visit marine sanctuaries: an exploratory study. *Ocean & Coastal Management* 45,171-183.

This paper reports about an exploratory contingent valuation study that was carried out among foreign and local tourists in three major dive destinations in the Philippines to examine diver demand for visits to protected coral reef areas.

2) King O. H. (1995). Estimating the Value of Marine Resources: A Marine Recreation Case. *Ocean & Coastal Management* 47, 129-141.

This paper discusses the relevance of economic valuation to marine environmental resources. It gives a review of the difficulties of placing monetary values on non market environmental goods and services. A case study which uses contingent valuation to estimate the use value associated with a recreation beach is presented.

3) Ledoux L. and Turner R.K. (2002). Valuing ocean and coastal resources: a review of practical examples and issues for further action. *Ocean & Coastal Management* 45 583-616.

This review article examines the importance of valuing environmental resources in the context of sustainable development. The authors present practical policy-relevant valuation examples, and conclude by outlining progress since 1992 and remaining challenges. The authors argue that economic valuation provides useful information to decision-makers and should be part of a holistic decision-making process, while baring in mind its limitations.

4) Parsons George R., Helm Erik C. And Bondelid Tim (2003). Measuring the Economic Benefits of Water Quality Improvements to Recreational Users in Six Northeastern States: An Application of the Random Utility Maximization Model. U.S. Environmental Protection Agency's Office of Policy, Economics, and Innovation through Cooperative Agreement CR82486-01-0.

This paper estimates the economic benefits of water quality improvements for recreational users of lakes, rivers and coastlines in six northeastern states in the US. The benefits are measured using separate travel cost random utility maximization models for fishing, boating, swimming, and viewing. The authors considered several scenarios for water quality improvements and estimate annual benefits in the region due the Clean Water Act to be near $100 million per year.

### Additional references:

The following books cover the topics and are devoted entirely to valuation techniques:

Bateman, I. and K.G. Willis. Valuing Environmental Preferences: *Theory and Practice of Contingent Valuation Method in the US, EU and Developing Countries*. Oxford University Press, 2002.

Champ, P.A., K.J Boyle and T.C. Brown (eds.). *A Primer on Nonmarket Valuation*. Kluwer Academic Publishers, 2003.

Nunes, P.A.L.D. *The Contingent Valuation of Natural Parks*. Edward Elgar Publishing, 2002.
Ward, F.A. and D. Beal. *Valuing Nature with Travel Cost Models*. Edward Elgar Publishing, 2000.



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

## Appendix 5.1: Using Spreadsheets to Run Regressions

Regression analysis is a set of statistical techniques that quantify the dependence of a given variable on one or more other variables. The method requires a set of observations on the explaining and explained variables. It then tries to find an equation that best summarizes the relationship among its variables.

Today most spreadsheet programs give you the power to run multiple regression programs. We will briefly mention here how to use Microsoft's Excel spreadsheet. This short appendix is NOT a replacement for looking up at the Excel help menu but it gives you at a glance the steps in order to run a regression on the spot.

In order to call up the regression program, one needs to look at the TOOLS menu and select DATA ANALYSIS. The next step is to select REGRESSIONS and click OK. A regression dialog box will appear. In this dialog you need to select the range of cells where the explained variable appears while standing on the **Input Y range** in the dialogue box. Then you should select the cells of the explaining variables while standing on the **Input X range**.

The regression program needs to be told where to put the output. This is known as the **OUTPUT RANGE**. Simply type a cell name. The program will start with that cell and to the right and down. It really does not matter where you put the output except you don't want to put it over the data, thereby destroying them.

To run the regression, simply click OK.

It is important to look at the coefficients and their significance in the output you will get in order for a variable to be significant, its t-value should be more than 1.5. Other important variables to look at are the **adjusted R-sq**. and the **F statistic**. The first one tells you how much of the variance in the explained variable is explained by the explaining variables. Of course, as much as it is closer to 1, you have a better model. The second one tells you if you should ignore the regression model altogether (contrary to the t-value which tells you if you should ignore one variable at a time).

## Appendix 5.2: Theoretical issues in designing a survey

The purpose of this appendix is to demonstrate which points should be taken into consideration when planning a questionnaire.

A few general points, before we start that must be taken into account when conducting an interview or submitting a questionnaire:

1) Please note that the questionnaire is long. It is advised to locate a comfortable spot for conducting the interview and letting the respondent know for approximately how long it will take.

2) Another point you might want to think of is the use of a picture. Remember, we are trying to create a hypothetical market or scenario with the help of pictures. It is worthwhile investing your time and money in getting good quality pictures that explains the situation well.





### Part A: General Recreational behavior

Usually, the first part of the survey consists of asking people about their recreational behavior. This is done after a short introduction in which the interviewer presents himself as well as the institution he is working for. The interviewer should also encourage the respondent to pay attention to his answers and answer in the most honest way possible. In general, it is preferred to ask closed form questions. Some questions that might appear at this section include:

*How many persons are in your group?*
*How many times do you visit the site during the year?*
*Why did you come to the site today (main reason)?*
*How long do you plan to stay on the site?*
*During which seasons are you usually coming to visit the site? Only this one? Others?*

Each one of these questions can be formatted and written in a closed format.

### Part B: Travel cost related questions:

This part is intended to reveal the means by which the respondent came to the site, the time it took him to get there, how long does he plan on staying at the site and any other related expenditures. The purpose of these questions is to get information for calculating the visitor's travel costs, including the value of time. Questions in this part may be such as:

*Where do you live?*
*How did you come to the site?*
*Do you have a rough estimate about how much did it cost you to get to here today?*
*Did you hire or buy anything at the site today?*

### Part C: Contingent Valuation related questions:

As explained in the text, this section must include the following parts:

- Explanation of the current ecological system.
- A theoretical explanation as to what will happen under certain circumstances to the site. These circumstances might include development scenarios, lack of enforcements etc.
- Explanation that in order to better understand the value of the ecological resource, the respondent is going to be asked how much he is willing to pay to prevent the negative scenario from happening.
- Stressing the fact that there are budget limits and other activities or purposes the respondent might be willing to contribute to.
- Then comes the payment question which is called the WTP question. For example, if the survey is conducted with a referendum type questions (Double - Bonded) then, a relevant questions might be:

*If the total amount of tax paid for water treatment and monitoring would be $15 per year, would you agree to vote for the program?*

If he answers "Yes", the next question might be:

*And how about $45?*

But if he answered "No" to $15, the next question should be:

*So how about $5*

As we can see, there is a problem if the respondent answers "Yes" or "No" to both consecutive questions. In this case, there are two options:

One option is to decide arbitrarily about a higher bid which is usually twice than the last one. For example, in our case, we would record the maximum WTP of a respondent who answered "Yes" to $15 and "Yes" to $45 as $90.

The other option is to follow up with an open question such as:

*What is the most you would be willing to pay?*

The same goes with a "No" "No" sequence of answers. One option is to record the maximum WTP as half of the last bid, meaning $2.5 in our case (some researchers record it as zero). In this case, the second option would be to follow up with an open question such as: Are you willing to pay anything at all? If yes, how much?

### Section D: Demographic and Socio-Economic related questions:

The purpose of this section is to better understand the respondent's socio economic position and how it affects his willingness to pay. Questions at this section might include:

*How old are you?*
*What is your highest degree?*
*What is your field of education?*
*What is your marital status? (Married, divorced, single...)*
*How many children do you have?*
*I will represent to you some ranges of income. Please state which one describes your situation.*

Please note, that it has been known that such questions may cause antagonism, and some respondents may consider them as an invasion of their privacy. You need to give some thought as to the way you phrase these questions and always be ready for people not willing to answer them.

We would like to present you with two questionnaires dealing with valuation of MPAs. We added explanatory comments along the questionnaires. These sentences, which are addressed to our reader, are written in italic bold font in a darkened frame.

1) Orange County Rocky Internal Zone





Hall D.C., Hall J.V. and Murray S.N. (2002). Contingent Valuation of Marine Protected Areas: Southern California Rocky Intertidal Ecosystems. Natural Resource Modeling, Vol. 15, No. 3, Fall 2002.

This is an example of a structured interview that was conducted as part of a valuation study of a Marine Protected Area in California, USA. The authors used a double-ended question model for their WTP question, as you will see below.

Name of interviewer: _____
Location: _____
Date: _____
Interview start time: _____

Good Morning/Afternoon, My name is _____ and I am a graduate student in the Department of _____.
We are conducting a research project and I was wondering if you would be willing to answer some questions for me.
As a research project, we are interviewing people about _____beaches. All individual answers to questions will be treated as confidential.

Are you over 18 years old? ___Yes ___No. Do you live in this region? ___Yes ___No
Is this beach close enough to your home to be a day trip? ___Yes ___No

Hand **CARDS** to respondent.

### Section A: Programs Affecting Attributes of the Coast

**Now Please Look at Card A**

These are just a few of the programs for which local municipalities, regional county and national government spend tax money:
Maintain Beach Cleanliness; Maintain/Improve Marine Wildlife Habitat; Maintain/Improve; Parks and Greenbelt; Marine Safety; Protect Wildlife; Lifeguards at Beaches. SEE **CARD A**

**Q1:** For each item on **CARD A**, is this issue not important at all to you personally, not too important, somewhat important, very important, or extremely important?

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | Not important at all | Not too important | Somewhat important | Very important | Extremely important |
| **a** Maintain beach cleanliness | | | | | |
| **b** Maintain/improve marine wildlife habitat | | | | | |
| **c** Maintain/improve parks and greenbelt | | | | | |
| **d** Marine safety/coast guard | | | | | |
| **e** Protect terrestrial wildlife | | | | | |
| **f** Lifeguards at beaches | | | | | |

Proposals are sometimes made for new programs, but additional programs have additional costs that require funding. One way to find out about this is to give people like you information about a program so that you can make up your own mind about it. Your views are important to decision makers when deciding what, if anything, to do about a particular situation. In interviews of this kind, some people think that the program they are asked about is not needed; others think that it is. We want to know what you think.

I am going to ask you about a program that intends to increase the abundance and diversity of marine plant and animal life of Orange County beaches in the Intertidal Zone.

## Section B: Recreation Participation and Intensity

I will begin with some background information. Then I will ask you whether you think this particular program is worthwhile and why you feel the way you do.

**Now Please Look at Card B**

**Q2:** In what recreational activities have you participated at _____ beaches during the past 12 months? (Circle all that apply) fishing, tide-pooling, sunbathing, sitting, walking, bird watching, swimming, diving, snorkeling, surfing

**CARD B:** Side 1 - Fishing, tide-pooling, sunbathing, sitting, walking, bird-watching, swimming, diving, snorkeling, surfing.



**CARD B:** Side 2 - Map of Orange County beaches.

**Q3:** About how many trips did you take during the last 12 months? _____

If None, skip Q4.

**Q4:** Which Beaches?

_____

_____

**Q5:** Do you plan any trips during the next 12 months? _____

**Q6:** About how many trips will you take during the next 12 months? _____

**Now Please Look at Card C**

**Q7:** Other than _____ beaches, did you participate in any outdoor recreation activities during the past 12 months? _____Yes _____No. If No, skip to Q10.

**CARD C:** Side 1 - mountains, lakes, rivers, beaches.
Side 2 - southern California Map.

**Q8:** Where did you go? _____

**Q9:** How long did you stay? _____

**Q10:** How many trips will you take during the next 12 months? _____

**Section C gives a description of the subject, before getting to the actual problem.**

Section C: Contingent Valuation - Stress and Shock to Ecosystem

Along the Orange County coast, there are three different types of shoreline
☐ Wetlands
☐ Rocky Shorelines
☐ Sandy Beaches

I want to describe to you the portion of land that is the purpose of our study.

**Now Please Look at Card D**

**CARD D** - Side 1: This is a picture taken from the Treasure Island Intertidal Zone, showing the nearby beach within the city of Laguna Beach. It is a representative of other rocky intertidal zones in Orange County. Side 2: These are pictures of the Treasure Island Intertidal zone.

We want to learn more about the value users of coastal resources place on the portion of land.

California's coastal resources are intensely used for recreational, scientific, educational, and commercial purposes[1]. Human activities, including lawful and unlawful harvesting, visitor foot traffic and human movement of plants and marine animals are impacting the rocky intertidal ecosystems throughout the state.

**Now Please Look at Cards E and F**

**CARDS E** and **F**: These cards show some types of animal and plant organisms that make their home in the intertidal zone.

**Q11:** Are you familiar with any of the organisms in the intertidal zone?
_____Yes _____No _____Not Sure

According to marine biologists, none of these organisms is in danger of becoming extinct. Let me describe three common organisms:

Owl limpets (Lottia gigantea Sowerby) change sex from male to female with age. Therefore, harvesting of larger, and presumably older, individuals removes the females, altering the reproductive capacity of this species. A similar species is the Fingered Limpet. (Point to Fingered Limpets on **CARD E**).

Research shows that many marine animal organisms, such as those shown on the card, are susceptible to damage from visitor foot traffic and illegal takings.

Please look at organism #1 on **CARD F**:
Mussels (Mytilus californianus Conrad) generally form dense beds in the intertidal zone, with individual animals fastened to the rocks and linked to each other by tough strands of protein. They form habitat for a high diversity of marine life, which lives within and is dependent on the bed. According to a scientific study, one of the most frequently observed forms of harvesting on local shores was the removal and use of mussels for fishing bait and food.

Please look at organism #2 on **CARD F**:
Rockweeds (Pelvetia compressa and Herperophycus californicus) and other canopy-forming seaweeds provide important habitat for numerous species of algae and invertebrates throughout southern California, and have been found to be particularly vulnerable to human foot traffic. According to marine biologists, none of these marine plants or animals is in immediate danger of becoming extinct. However, a reduction in the local quality or size of these organisms affects the rest of the marine environment. The overall impact of degradation of abundance and diversity of intertidal zone life is that it negatively affects the food chain.

Reminder: I would like to remind you that our primary concern is plant and organism life within the rocky intertidal zone, not air, water, or beach pollution.

[1] The marine biology content of this qyuestionnaire is from: Steven N. Murray , "Effectiveness of Marine Life Refuges on South California Shores", Departament of Biological Science, California State University, Fullerton, P.O. Box 6850, Fullerton, CA 92834-6850.



**Section D: Description and Attributes of _____ beach - Policy Options, Payment Mechanisms, Willingness to Pay**

**Q12:** Do you feel that the habitat I have described has a value to today's society or future generations and is worth protecting? _____Yes _____No _____Not Sure

There are 21 designated "California Marine Life Refuges" (CMLRs) along the California coast. These public areas are designated, but lack enforcement by the California Department of Fish and Game, a state agency, which is responsible for protecting natural habitats in the ocean's intertidal zone.

Some areas (such as in Laguna Beach) have had marine refuge protection for more than 25 years. However, recent scientific studies suggest that the intertidal zones in many Marine Refuges are not much healthier than non-refuge sites. A reason is believed to be poor enforcement of the Marine Refuge regulations.

**Now Please Look at Card G side 1**

Present Marine Refuge regulations are - **CARD G side 1**
☐ Recreational fishing is allowed
☐ It is unlawful to collect or harvest most species of invertebrates* and marine plants
☐ Except for collecting and harvesting organisms, there are no restrictions on visitor access or most forms of recreational activity.

* Instead of internal backbones, they have external shells like clams or crabs.

Presently, beach lifeguards in some areas pass out Ecological Advisements to people engaging in ecologically damaging activity within the intertidal zones. These Advisements are not legally enforced.

So, two problems have been identified. One is lack of sufficient funding for enforcement of existing regulations to avoid illegal harvesting and collecting. The other is damage to ecosystems from trampling and overuse.

**Now Please Look at Card G side 2**

This part presents the respondent with the proposed change - using the payment vehicle of a Marine Protection Wildlife Fund financed by taxes.

One proposal is to create a Marine Wildlife Protection Fund financed by taxes. Proceeds from this fund would pay for greater enforcement of marine wildlife regulations and more intensive enforcement of harvesting regulations to reduce poaching.

The proposal would also provide a mechanism to reduce the effects of foot traffic and human impact on the intertidal zone. Setting aside some tide pools as off limits, so they can regenerate and seed the surrounding areas would accomplish this. Another possibility is pathways for foot traffic through environmentally sensitive sections of the intertidal zone.

ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

A Marine Wildlife Protection Fund financed by additional taxes each year would pay for these programs.

**Hypothetical Bias** We are going to ask you if you are willing to pay additional taxes. Before we ask you our question, think about referendums on the ballot that allow you to vote in favor of programs to improve the environment. In those votes, you actually give permission to increase your taxes. Since you are not actually voting on a referendum, the increase in taxes is hypothetical. Some researchers are concerned that when payment is hypothetical people will overstate the amount they are willing to allow taxes to be raised. We call this hypothetical bias, the difference between the amounts people respond to hypothetical situations as compared to real situations. We want to get people to think about their taxes in a hypothetical setting like they think in a real situation, where if they agree their taxes will really be raised, and they will have to really dig into their pocket and pay money. One reason offered to explain hypothetical bias is that when there is a real vote, we think a different way: if I spend money on this, then I have less money to spend on other things, and we take into account the limited amount of money we have. So if I were in your shoes, I would ask myself: if this was a real election, and I had to pay $X in increased taxes for the referendum to win, do I really want to spend my money this way? In any case, I ask you to answer just exactly as you would vote if you were really going to face the consequences of your decision: which is to pay increased taxes if the referendum is passed.

**Now Please Look at Card G Side 2**

This is the double-bounded WTP question. The interviewer selects randomly any number from those written in brackets for his first question (Q13). The second question (Q14) depends on the respondents answer to the first one: If the answer is "No", the interviewer will reduce the amount he previously suggested by 0.5. If the answer is "Yes" the interviewer will double the amount he previously asked. Q15 is asking the respondent to explain the reasons for choosing the amounts he has chosen. The answers to this question (Q15) can give the interviewer an estimate about use and non-use values that affect the respondent's choice.

**Q13:** Would you be willing to pay $_____ in additional taxes per year? (Amount randomly selected from 2, 5, 10, 15, 20, 30, 40, 50, 70, 90, 100) _____Yes _____No

**Q14:** Would you be willing to pay $_____ in additional taxes per year? (Amount equals .5 x previous answers if no; amount equals 2x previous answer if yes) _____Yes _____No

**Q15:** Please explain your answers to the last two questions

_____

Q16 void

**Q17:** Would you be in favor or not in favor of greater enforcement of Marine Refuge laws, which include laws prohibiting harvesting? _____In Favor _____Not in Favor _____Not Sure

**Q18:** One specific program would permit beach lifeguards to summon law enforcement upon viewing unlawful activity within intertidal zones. Are you _____In Favor _____Not in Favor _____Not Sure



**Q19:** Another specific program would temporarily reduce access to some portions of rocky intertidal zones to improve abundance and diversity of marine life. An example might be restricting access to some environmentally sensitive areas for restoration and rejuvenation. Are you _____In Favor _____Not in Favor _____Not Sure?

## Section E: Contingent Behavior - Prospective Changes in Recreation

There are areas in the rocky intertidal zone of San Clemente Island that have not been affected by humans. The size, abundance, and diversity of marine animals and plants are greater than any of the sites in Orange County. If the sites along the coast in Orange county became more like the pristine sites off San Clemente Island.

**Now Please Look at Card H**

**CARD H:** Map of Orange County Beaches

**Q20:** About how many trips would you take during a year? (Refer to the answers to Q3 & Q5 before answering; note, not additional trips) _____

**Q21:** To which Beaches?

_____

_____

## Section F: Travel Time - Household Wage, Income, Residence

I want to ask you about your background. This information will help us understand what you are willing to give up in terms of time and wages in order to participate in outdoor recreation.

**Q22:** In what zip code do you live? _____

**Q23:** Are you employed part or full time? _____Part Time _____Full Time

**Q24:** If neither, are you a homemaker, student, retired? (Circle applicable answers)
Other _____

**Q25:** If part time, how many hours per week do you work? _____ weeks per year? ____

**Q26:** If full time, how much time do you receive for Vacation? ____ Days/Weeks/Months

**Now Please Look at Card I (circle)**

**Q27:** Which describes your Weekly or Monthly (circle one) take-home pay? **CARD I** ____

**Now Please Look at Card J**

**Q28:** Which best describes the total annual income, before taxes, for everyone who lives in your household? **CARD J** _____

## Section G: Socio-economic Variables

**Q29:** What is your age? _____

**Now Please Look at Card K**

**Q30:** What is your highest level of education? Show **CARD K** _____

**Q31:** How many people other than yourself live in your household? _____

**Q32:** What are their ages? _____

*Q32A:* How many are wage earners? _____

**Q33:** Do you think of yourself as a "concerned environmentalist?"
_____Yes _____No _____Not Sure

**Q34:** Do you regularly contribute to environmental causes or any environmental group(s)?
_____Yes _____No _____Not Sure

**Q35:** Which one(s)
_____

**THANK YOU!**

**Section H: Information from the Interviewer**

Please answer the following questions about the respondent.

**Q36:** Sex _____Male _____Female

**Q37:** Race _____White _____Black _____Hispanic _____Asian _____Other

The Respondent was:

| | 1.Extremely | 2.Very | 3. Somewhat | 4. Slightly | 5. Not at All |
|---|---|---|---|---|---|
| **Q38:** Distracted | | | | | |
| **Q39:** Attentive | | | | | |
| **Q40:** Interested | | | | | |
| **Q41:** Impatient | | | | | |



**Q42:** Did the respondent say anything suggesting that s/he had any difficulty understanding what the intertidal zone is? _____Yes _____No

Describe _____
Interview Ending Time: _____
Weather Condition:
Temperature: ____Hot ____Warm ____Cool ____Cold
Precipitation ____Sunny ____Cloudy ____Drizzly ____Rainy
Smog: ____Heavy ____Moderate ____Light
Tide: _____

## 2) Survey of Non-consumptive Users of Coral Reef in the Florida Keys

The second survey we would like to present you with is part of a research done by Bhat (2003) in the Florida Keys. In this study, the researcher used a slightly different way of soliciting the respondent's WTP. Respondents were presented with five hypothetical scenarios of environmental improvements, but were not directly asked about their WTP for these improvements but how these improvements will affect their visitation rate.

Bhat Mahadev (2003). Application of non-market valuation to Florida Keys Marine reserve management. Journal of Environmental Management 67: 315-32.

Your participation in the interview is voluntary. There are no penalties for not answering some or all of the questions. You can refuse to answer any questions during the interview process or stop the interview at any time. No question in the questionnaire will identify you as an individual. The purpose of this study is to evaluate potential recreational benefits associated with the proposed regulatory and zoning plans for protecting the coral and other marine resources in the Florida Keys. This study is being conducted by the Florida International University, Miami.

Interview Site: _____
Name of the Reserve: _____
Type of Day: ___ Weekday ____ Weekend ____ Holiday

### 1. Some general questions about your current trip

1. What is the primary purpose of your trip to the Florida Keys?

   Recreation or vacation ___ Business/pleasure combined ___
   Visit Family or Friends ___
   Business ____ other (specify) _____

2. What is the primary recreational activity you are here for?

   Glass-bottom boat riding ___ Scuba diving _____
   Snorkeling ____ Recreational Fishing ___

3. How many miles and hours did you travel to this location from your primary residence including travel to other places?

Miles _____ Hours _____

4. How many days in total will you spend away from home during this entire trip, not including travel time? _____

5. If visit to this particular location is NOT the SOLE purpose of this trip, what portion of your trip (time-wise) would you spend on visiting this particular recreational site?

In days _____ **OR** In hours _____ **OR** In Percentage _____

6. Including this visit, how many times did you visit any recreational site in the past FIVE years in the Florida Keys?

To this site _____ To other sites in the Keys _____

Average # of days you spent during each visit (please circle one):
0.5 1 1.5 2 2.5 3 3.5 4 more

During the above visits, how many times did you participate in
Glass-bottom boat riding _____ Scuba diving _____
Snorkeling ____ Recreational Fishing ___?
Other activity (specify) _____

7. During each visit, on an average how many boats (commercial or recreational) or other visitors did you encounter WHILE you were engaged in a recreational activity?

_____

8. On this trip, are you paying your own expenses, sharing expenses or is some else paying your expenses?

☐ Own expenses Besides your own expenses, how many other people are you paying for on this trip? _____

☐ Shared expenses How many other people are you sharing expenses with? _____

☐ Someone else paying What portion of your expenses is paid by others? _____

9. What mode of transportation did you use to get to South Florida from your primary place of residence?

Automobile - Private _____ Air _____ Automobile - Rental _____

Cruise Ship _____ Other _____



## II. Some questions about your visitation preference with respect to the quality of the coral reef and other marine resources

**Interviewer, STOP. The following is THE key question of this survey. Take your time to clearly explain the meaning of this question to respondents.**

As you may be aware, the newly established Florida Keys National Marine Sanctuary is planning to establish several restricted zones in the Keys in which all types of consumptive uses (specially commercial fishing) will be restricted in the future.

Some of the features of the proposed plan are:

1. Establishment of 19 **Sanctuary Preservation Areas** (SPA) to protect heavily used, shallow reefs from concentrated visitor activity which has partially led to coral reef degradation.

2. Prohibition of the following user activities in the SPAs:
   Taking or harvesting of corals, marine animal species, algae, seagrass, shells, etc.
   Touching living or dead coral.
   Fishing by any means (commercial or recreational).
   Placing any anchor allowing its parts to touch living or dead coral.

You just said that you visited the Florida Keys ____ (refer to q. 6 in section I) times for recreation in the past five years. We would like to show you a couple of pictures which best represent the **CURRENT** quality of corals and fish community.

**Interviewer: Please show pictures #1 and 2 to the respondent (Pictures of corals with only few fish).**

Assume that your personal (financial and demographic) situations will remain the same as of now; please indicate how many times you would VISIT this or other recreational site in the Florida Coral Reefs in a FIVE YEAR period under the following scenarios:

| My # visits to the Florida Keys coral reefs in a FIVE year period will remain/be | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SCENARIO 1 (Larger fish population) | THE SAME AS NOW | 10 % MORE | 25 % MORE | 50 % MORE | 75% MORE | 100 % MORE | 150 % MORE | 200 % MORE | 300 % MORE |
| Large improvement in fish and other marine animal populations as a result of the establishment of No-Take Marine Reserves<br><br>SHOW PICTURES # 3, 4, 5 & 6 | | | | | | | | | |

| My # visits to the Florida Keys coral reefs in a FIVE year period will remain/be | | | | | | | |
|---|---|---|---|---|---|---|---|
| SCENARIO II (Smaller fish population) | THE SAME AS NOW | 10 % LESS | 20 % LESS | 30 % LESS | 50% LESS | 75 % LESS | 100 % LESS |
| Over-exploitation of fish population in the coral reef (likely to happen in some areas if the Marine Reserves are not established)<br><br>SHOW PICTURES # 7 & 8 | | | | | | | |

| My # visits to the Florida Keys coral reefs in a FIVE year period will remain/be | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SCENARIO III (Less visitor congestion) | THE SAME AS NOW | 10 % MORE | 25 % MORE | 50 % MORE | 75% MORE | 100 % MORE | 150 % MORE | 200 % MORE | 300 % MORE |
| Decline in visitor congestion from commercial and recreational fishermen -an immediate benefit of of establishing No-Take Marine Reserves | | | | | | | | | |

The current under water visibility in some places you have visited might have been poor as represented in the following pictures. **SHOW PICTURES # 9 & 10**.

If you think above is true, then assume that due to certain water quality improvement programs, the underwater visibility of coral reef improves to a level as represented in the following pictures. SHOW PICTURES # 5 & 6.

Now please tell us if your number of visits in a FIVE year period might change because of the water quality improvement.



| My # visits to the Florida Keys coral reefs in a FIVE year period will remain/be | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SCENARIO IV (Improved water quality and visibility) | THE SAME AS NOW | 10 % MORE | 25 % MORE | 50 % MORE | 75% MORE | 100 % MORE | 150 % MORE | 200 % MORE | 300 % MORE |
| Improved water quality and visibility due to certain water quality program | | | | | | | | | |

In certain areas you have visited, corals might have been dying or being severely degraded. The following picture best represents the current DEGRADED quality of corals in certain areas. **SHOW PICTURE # 11**.

If you think above is true, then assume that due to various management actions, the health of corals would improve to a status as represented in the following picture. **SHOW PICTURE # 12**.

Please tell us if your number of visits in a FIVE year period might change because of the water quality improvement.

| My # visits to the Florida Keys coral reefs in a FIVE year period will remain/be | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SCENARIO V (Coral health improvement) | THE SAME AS NOW | 10 % MORE | 25 % MORE | 50 % MORE | 75% MORE | 100 % MORE | 150 % MORE | 200 % MORE | 300 % MORE |
| Improved coral quality | | | | | | | | | |

## III. Profile of the respondents

**Reminder: You may refuse to answer any questions.**

1. What is your age? _____ years
2. Are you married? ___ Yes ___ NO
3. Are you? __ Female __ Male (Interviewer: Don't ask this question; please mark it accordingly)
4. Including yourself, how many people are there in your household? _____

5. Please indicate the appropriate category for total household income before taxes in year 1995?

| | | | |
|---|---|---|---|
| ____ | <$10,000 | _____ | $40,001 - $50,000 |
| ____ | $10,001 - $15,000 | _____ | $50,001 - $60,000 |
| ____ | $15,001 - $20,000 | _____ | $60,001 - $75,000 |
| ____ | $20,001 - $25,000 | _____ | $75,001 - $100,000 |
| ____ | $25,001 - $30,000 | _____ | $100,001 - $150,000 |
| ____ | $30,001 - $35,000 | _____ | >$150,000 |
| ____ | $35,001 - $40,000 | | |

Refuse to answer _____

Thank you very much for your cooperation.



# 6. Financial Issues in Managing MPAs

## 6.1. Introduction

Well-managed marine protected areas (MPAs) usually have three common ingredients: (i) they contain the necessary capacity to plan, manage and monitor the protected area and plan for the long term; (ii) they possess a high level of financial stability which ensures a continuous level of management and includes a diverse revenue stream; and (iii) they provide stability to the economies of the communities living in and around them.

The capacity to plan, manage and monitor financial and other management activities is clearly essential for a successful MPA. A long-term, steady and diverse income stream is also an obvious ingredient for financial stability. This includes (a) income from a variety of sources, such as entrance and user fees, taxes, concessions, trust funds, donor funds, and resource extraction fees, and (b) a long-term planning horizon. Less evident may be the significance of a stable economy surrounding the MPA. For the MPA, this may include working with local stakeholders to establish multi-use scenarios, including non-consumptive as well as consumptive activities in and around the MPA. It may also include involving local communities in the management of the MPA and providing opportunities and incentives for businesses that support the MPA. Overall, a more balanced economic setting in and around the MPA is one where the majority of stakeholders are able to benefit from the protection of the resources. Financial and economic mechanisms help to achieve this mix, ensuring that revenues from activities in areas surrounding the MPA contribute directly and indirectly to the management of the protected and surrounding area.

## 6.2. Planning a Financial Stable MPA

### Economic Analysis:

Economic analysis provides a foundation for achieving financial and economic sustainability in and around MPAs and thus should be utilized in MPA design, as well as in MPA implementation. Economic analysis is most useful for highlighting the values of the MPA to decision-makers and other stakeholders and clearly identifying the economic benefits and opportunity costs of protecting the resource.

To date, significant progress has been made in understanding the bio-economic implications of different management options. However, much less is understood about the economic effects of MPAs and particularly about how gains and losses might be received by different stakeholders. Yet this information is critical for the support and ultimate long-term success of the MPA. The ecological advantages of MPAs need to be translated into economics in the language of policy makers to advocate for adequate support from decision-makers.

Total economic value and decision making: The concept of Total Economic Value (TEV) provides a framework that can help (1) determine the size and location of an MPA and (2) secure commitments and resources to protect and manage MPAs.

TEV can be calculated by identifying the full range of detrimental impacts on the MPA (and the individuals and groups causing the damage) as well as the full range of benefits emanating from the MPA (and the stakeholders receiving these benefits). This information can also be used for option appraisal, assessing losses from damage to marine resources, developing and applying appropriate market-based instruments for raising revenues and developing strong arguments for raising finances from government and donor groups and for encouraging investment from industry.

However, it should be noted that overall economic conditions may not always improve with a well-managed MPA. There will always be winners and losers, and at times the economic losses may be greater than the benefits received. Clearly it is important for MPA managers to understand this dynamic and seek solutions for an economic balance in the MPA and surrounding area.

Economic Analysis and MPA Management: By identifying the full range of economic and financial benefits emanating from MPAs, economic analysis helps MPA managers to capture rents through the resource itself. For instance, international visitors might be willing to pay more to visit the MPA. One method for determining an optimal fee is contingent valuation method (chapter 5) followed by adjustments according to visitors' actual behavior. However, it is important to note that there are other factors to consider when setting entrance fees. For example, in Bunaken National Park, in Sulawesi, Indonesia, (Elliott et al. 2001) there was an incentive to keep the fee low for the first year. Larger returns might have encouraged other stakeholders (particularly the local government) to lobby for a larger percentage of the fee rather than support reinvestment of all earnings back into the park. Starting with a relatively low fee was also a good way to "test" the new system.



The Local Context and Economic Analysis: Economic analysis can also help to identify and establish partnership and investment opportunities with local communities and local industry. Collaborative analysis with communities and industry makes this process more transparent. From this perspective it is important to measure the added value of the MPA (rather than the TEV of the resource being protected by the MPA). This will indicate the value of protection that the MPA is providing. A cost-benefit analysis compares the net benefits of protection (i.e. the direct and indirect benefits that stakeholders receive from the area) with the costs of management and the opportunity costs of the park (foregone fish catches and marine product yields from restricted areas).

## 6.3. Business Plan

### Introduction:

Most Marine protected areas throughout the world do not have adequate funding to achieve their stated goals. One major obstacle in putting such key conservation areas on a sound financial base, is the tendency of conservation professionals to focus on park protection based on biological sciences and pay less attention the critical role of financial management.

The business plan can be considered an extension of the management plan: it aims to identify the resources required to meet the goals and tasks laid out in the protected area management plan.

### Marine Protected Area Management Plan - Overview:

**Marine Protected area (MPA) management planning** involves assessing and recording the conditions of a site; evaluating current and projected needs and threats; and developing strategies and planning specific activities designed to address those threats. MPA management plan should be considered as a dynamic technical document rather legal instrument. As such it has to be updated at regular intervals to adjust to changing conditions.

Planning in general should not be done in isolation by an individual, but rather should involve internal as well as external stakeholders. It involves defining tasks and responsibilities; timelines for achieving goals; benchmarks (or indicators) against which progress can be measured; and resource needs. A business plan for Marine protected areas should focus on this last aspect of the management plan. The business plan is intended to give a clear picture of: 1) the financial needs that must be met in order to conduct proposed management plan activities, and 2) potential revenue sources to help meet those needs.

### Phases in Management planning:

**Phase 1:** Good planning means setting the exercise in the proper context and thinking about the institution responsible for planning and what it wants to achieve. What are its mission and/or goals? What are the indicators or benchmarks against which to measure progress towards these goals?

As an example, the institution could be an Environment Ministry. Its mission could be to create a network of MPAs or to improve the management of an existing MPA. The goal could be

to have a biologically diverse and economically sustainable network of MPAs in a specific region or country.

**Phase 2:** The second phase consists of looking at the environment in which it is living and working: the institutional, social, economic, cultural, political and religious environment. This includes positive external forces (strong political commitment, NGO support, economic stability, good opportunities, etc.) and negative external forces (civil unrest, hunger, political instability, vested interests, drought, etc.). It also includes positive internal forces (capable institutions, well trained and qualified staff, adequate budget, good leadership, etc.) and negative internal forces (weak or marginalized institutions, lack of staff, poor incentives for staff, lack of operational funds etc.).

**Phase 3:** This phase involves actions you will take to achieve your goals. This management planning process takes place at three different levels: long-term, medium-term and short-term planning.

**a.** Long-term planning (or, "**strategic planning**") entails planning the implementation the broad objectives (what you want to achieve in five to ten years), e.g. a network of five well-managed Marine protected areas in a specific region. The objective could, similarly, be the efficient management of a park within the next eight years.
**b.** Medium-term planning (or, "**tactical planning**") entails defining medium term steps and time frames (in the next several years) to achieve your broad objectives. For example, to have a network of five Marine protected areas in your region, you need: (1) political support (2) public support (3) financial and non-financial means (4) qualified staff, etc. Tactical planning is more detailed than strategic planning and gives details on how to achieve the broad objectives.
**c.** Short-term planning (or, "**operational planning**") entails listing all the specific activities and means needed in the short-term (one year) to achieve the medium-term objectives. For example, to reach objective (4) above - have enough qualified staff - we need to define the specific staff positions, identify potential staff, train them, organize study tours, find funding for their salaries, motivate them, etc.

Goals should be linked to a list of tasks to be accomplished. The park management team can sub-divide these tasks into categories that fit their needs best. One example of broad management plan categories would be to break tasks down into scientific, socio-economic, and administrative tasks. These broad categories can be further subdivided, for example:

- *Scientific management*: ecosystem restoration, environmental monitoring and control, species reintroduction, control of invasive species, scientific research, etc.
- *Socio-economic management*: securing support from people in and around the park through employment opportunities, providing alternative livelihoods; public outreach and education; economic valuation of ecosystems goods and services, etc.
- *Administration*: staffing and training; patrolling and enforcement; infrastructure maintenance; overhead (office space, utilities, etc.); equipment and supplies; etc.

Park managers should make their best effort to adhere to the operational plan in order to meet medium-term objectives and hence the long term objectives, but they will also need to





be flexible and adapt their activities to respond to changing conditions. **Monitoring** and **evaluation** (M&E) is therefore essential to detect problems so that they may be addressed at an early stage. Spotting problems early will allow the planner to identify and implement corrective actions in time. These **corrective actions** might lead to a re-planning exercise to adapt the objectives to the new situation. This last step of the planning exercise is called the **feedback process** or **adaptive management**. M&E should remain easy to manage and oriented to practical needs, as it might otherwise develop into a full-grown project in itself (which is not its intention).

## Business Plan for MPAs:

### Motivation:

Before exploring the details of a business plan, we should answer the fundamental question: why take a "business approach" to protected area management? The idea behind this terminology is to encourage protected area managers to see their job, in part, as running a business. But in this case, the objective of the business is not to make a profit, but rather to improve the management of the protected area and make it financially as well as ecologically and socially sustainable. **Generating revenue is no more than a means to an end - improved park management**.

This business approach is based on the idea that protected areas provide real economic benefits to individuals and society as a whole. These contributions are often neither fully recognized, nor compensated. By identifying what are the environmental "goods and services" provided by an MPA (such as clean water, wildlife, tourist areas, etc.) and who are the "customers" or beneficiaries of the MPA, we can begin to quantify the monetary value of these benefits and generate payments for them. The business plan helps to summarize this valuation process and serves as a roadmap for implementing financial strategies that take advantage of biodiversity goods and services. As such, it identifies the financial sources and opportunities offered by a site for which existing and potential customers might pay.

### Preparing a Business Plan:

Preparing an MPA business plan requires an assessment of the protected area's resources and a plan for marketing these resources to meet financial goals. The first part of the business plan is to **identify the amount of financing required** to accomplish the goals. The second part of the business plan entails **identifying viable funding sources to meet these needs**.

Note that creating a business plan requires having your protected area management plan in order. This means having clearly defined long-term goals in place (the strategic plan) as well as detailed short-term goals and corresponding management activities (the operational plan). This should be apparent, as you cannot define your financial needs until you know exactly what you plan on doing at your site.

This is not to say that a comprehensive management plan must be completed before developing the business plan. On the contrary, it is best if the business plan is developed in concert with the management plan, so that they may influence each other. For example, if plan-

ned management activities in the short term are financially unrealistic, this will emerge in the business planning process and the management plan can be adjusted accordingly. But it should be understood that, by and large, the business plan is a means of achieving the management plan, not the other way around. Ultimately, the financial details and funding sources identified in the business plan will be incorporated into the management plan.

The first step is to make a commitment to develop a business plan. This may seem obvious but should not be underestimated. The preparation of a business plan requires qualified staff time and financial resources. Like the management planning exercise, it should be conducted by a group of key stakeholders who are familiar with the protected area. It is an investment, and as with all investments, the decision to proceed should be weighed carefully.

Once you have decided to proceed and have assembled your team, collect the data essential to create a long-term financial plan, and determine what the most promising sources of revenue are. As indicated above, the business plan should identify (a) your financial needs, now and in the long-term (b) the "goods and services" produced by your MPA (c) the economic value of these products, and (d) your potential "customers" (i.e. not just park visitors, but anyone who derives benefits from the goods and services the park produces). The sum total of this information can then be analyzed by the management team to make decisions: how to allocate resources more efficiently; where cost cutting measures may need to be made; when and to what extent cash flow problems may emerge; the new funding opportunities you will pursue; and how to begin.

## 6.4. Financial Revenue Options

Within the business plan, a diverse portfolio of income is optimal. Reliance on one single source of income, such as entrance fees or donor funding, can subject the MPA to financial risk. Tourism in particular is subject to political, economic and weather fluctuations. Donor funding is also likely to change with economic and political variations and usually is short-term (one to three years).

**General Revenue Mechanism:** Tourist fees, fiscal instruments (taxes) and private funds can be considered as general revenue mechanisms. In general, as much as the MPA has a larger national value and non-use component, a national fiscal tool is more appropriate. Use-values can be captured easily by entrance fee.

### Tourist Use Fees (TUF):

### Overview:

Every year, millions of tourists around the world visit Marine protected areas (MPAs). While MPAs often supply the most important part of such recreational experiences, they typically capture very little of the total economic benefits derived from ecotourism.

Tourism User Fee (TUF) can gather significant revenues from tourism-based activities, which can then be directed toward supporting MPAs conservation efforts. The fees partially reflect the cost of supplying recreational services, the demand for natural resources, and the value that visitors place on their experience at the site. The direct link between maintaining natural areas and income from user fees is a strong economic incentive for conservation.

Most TUF are site-level mechanisms (i.e. specific fees for specific activities are collected at PA sites). These site-based finance mechanisms are broadly referred to as visitor user fee (table 6.1).

**Table 6.1 Types of Tourism User Fee in MPAs**

| Fee Type | Description | Examples |
|---|---|---|
| Entrance fee | Charge for entering an MPA. | Fees collected at entry gates. |
| Concession fee | Charges or shares of revenue paid by businesses operating within MPAs, providing services to visitors. | Fees to operate restaurants, hotels, eco-lodge facilities and souvenir shops. |
| General user fees | Fees paid by visitors to use facilities within the PA. | Fees to use parking lots, campsites, visitor centers, boats, shelters. |
| Royalties and sales revenue | Money from sales of consumer goods. | Fees on recreational equipment, souvenirs. |
| Licenses and permits | Instruments required for private firms (or individuals) to conduct activities on MPA property. | Permits for tour operators and guides for scuba |

The right combination of user fees often can provide a significant portion of operating costs - but still typically not the total cost of protecting the resource. In particular, entrance fees - the most common type of TUF - have the potential to generate a large portion of the operating costs of a PA in locations where tourism volume is high and entry fees are also relatively high.

### Key actors and key motivations:

Visitor user fee involve four particularly relevant stakeholder groups. General motivations for each of these groups are outlined below:

*Marine Protected area managers* - MPA managers are typically governmental staff but can be NGOs or community-based organizations or their members. Managers generally seek to maximize Proprietary income from user fees that can directly support the operating costs of MPA management. Managers need to ensure that user fee mechanisms and associated services, such as lodging accommodations within an MPA, are consistent with and supportive of the overall conservation objectives of the MPA.

*Tourism related businesses* - This includes many different kinds of businesses, covering such industries as: food services; hotel and lodging; airlines; sport fishing, snorkeling, scuba diving and other water-based recreation; souvenirs and other retails sales. Generally, these businesses seek to maximize their profit and minimize the fees they are required to pay.

*Local Communities* - Local communities and governments seek income benefits from TUF. Local community members provide significant labor for tourism-related businesses, and can benefit at least indirectly when these businesses maximize their profits. On the other hand, large-scale businesses, in particular, can have harmful impacts on local community cultural values and traditions, especially if local participation or collaboration in management is diminished. Therefore, many local community members will seek to ensure that any business concession or permit schemes around MPAs require that businesses be sensitive to and supportive of such cultural values and traditions. Local and national governments are often the primary authority responsible for MPA management, and therefore are also, as with marine protected area managers, motivated to maximize proprietary income from user fees that can directly support the operating costs of MPA management.

*Tourists* - Tourists generally fall into two categories: foreign and domestic. In developing countries, there are generally large income disparities between these two groups. Fee differentials are applied: foreign tourists pay significantly higher user fee rates. Both categories of tourists generally are motivated to pay at least modest user fees if they are earmarked toward maintaining the MPA attributes that have inspired their visit. Many higher-income tourists are willing to pay significantly more than existing TUF rates.

Types of TUF:

Several broad categories are described below.

**Entrance fee** - This is a fee charged to visitors in order to enter a Marine protected area. There are a number of ways they can be collected - e.g. at the entrance to the site or at an administrative center. The most efficient method possible should be chosen to avoid unnecessary queuing and delays.

Marine protected areas present challenges in the collection of entrance fees because there are often multiple entry points, not all of which can be monitored. Therefore it is more difficult to ensure that all those entering the park have paid their fee. MPAs can require visitors to carry their tickets at all times. For example, at Bonaire Marine Park (Hawkins et al. 1999) and Wakatobi National Park (Elliott et al. 2001), visitors are given a waterproof tag which can be easily affixed to diving or snorkeling gear or backpacks. Enforcement is conducted through spot checks by park rangers both on land and at sea.

Differential fees are widely viewed as essential for the following reasons:

Residents of a destination country are already paying, through taxes, for MPA conservation, as well as encountering **opportunity costs** (e.g. reduced use of resources from the land now protected);





Environmental education and recreation objectives of MPAs will normally seek to encourage visits by local people, which would be discouraged with higher user fee rates; and foreign tourists from developed countries are generally willing and able to pay more for access MPAs. Entrance fee to MPAs in developing countries vary widely. The Galapagos, for example, charges foreign visitors a US$100 entry fee.

(http://www.galapagosonline.com/nathistory/nationalpark/nationalpark.htm).

Such relatively high fee is typically found only at internationally well-known MPAs, or at sites that have large numbers of "charismatic" terrestrial or marine wildlife species. A few marine protected areas that have outstanding and accessible coral reef and other marine life attractions are also able to charge relatively high fees. Entrance fee provide the greatest revenue contributions to ecotourism sites, primarily because they are the easiest fee to collect.

Entrance fee is primarily designed to increase funding available for the area's conservation activities. However, the pricing of entrance fee can also be a mechanism for facilitating or limiting visitor access. If managers of an MPA identify the need to limit visits because of the adverse impacts, raising the entrance fee is one tool to achieve this objective.

There is a need to communicate changes in fees in advance to tour operators, guide book authors, etc., in order avoid surprises to foreign visitors at the gate. Such changes require a thorough knowledge of the demand for a site's attractions before the effect of changing the fee can be reasonably predicted.

An example of such a survey is demonstrated in the appendix to this chapter.

**Concession fees** - These fees are typically collected from companies that are granted "concessions" for providing a service to visitors within an MPA site. Concession contracts between the concessionaire and appropriate legal authority include specific provisions specifying the pricing of the fee, the collection mechanism and other logistical, financial and legal details. Depending on the legal framework of the country, any function - including the management of the entire MPA or operation of specific facilities - can potentially be contracted to a concessionaire. The most common services provided through concession contracts include: lodging, food and beverage services, recreational equipment rentals, guided tours and boat transportation and gift / souvenir shops. At some sites, the MPA administration may choose to carry out all of these services without involving outside concessionaires. On the other hand, most site managers find that they either do not have the expertise or the investment capital needed to provide these services in a professional manner. This is typically a decision made by the management on a site-by-site basis.

Selection of concessionaires is usually done through a competitive bidding process in which the site's administration develops the terms of reference and interested companies apply, indicating the services they are offering and the amount they are willing to pay for the opportunity to provide these services. In the case of government-managed MPAs, this process can be long and involved. Concessions can be an excellent way to involve local people in MPAs - as either sole or co-owners of the concessionaire or employees of the concessionaire. This can help build local community support for the MPA.

A concession may not be a viable option for some sites, particularly if there is limited demand for the service. In some cases, there may be demand but not the entrepreneurs with sufficient capital, interest and risk-taking ability. A concession should not be undertaken unless a marketing study and business plan are prepared

One particularly difficult aspect of concessions is arriving at a balance between the amount that the concessionaire will earn by exploiting the resource, and the amount that will be returned to the MPA administration.

Concession fee income can be structured in different ways. The major options include:

- Fees based on the number of people a concession serves during a given year
- Fees based on a percentage of the gross or net income of the concessionaire
- Annual fixed fee
- A combination of the above

In many situations, it can be difficult for the concessionaire to track and calculate profits, income and number of people served. A fixed annual fee provides a simpler way to charge a concessionaire, but lacks flexibility: the concession may be steadily increasing its business while the annual fee remains the same. It is not unusual for concessionaires to make huge profits while site administrations receive very little in fees. It is important to be creative in setting concession fees at appropriate levels for all parties and using fee income methods that are easily calculated.

It is particularly important for the site administration to retain control over the concessionaire's operations to assure that resources are not over-exploited or damaged, and that protection and management functions are not neglected in favor of profit-making functions. As such, along with fee rates, the contract for concession operations should also require conditions that will assure preservation of the MPA. The site manager is ultimately responsible for ensuring that all standards and contract conditions are monitored periodically and complied with. Such responsibilities entail costs, which should be factored into the fee system.

Licenses and Permits - These are typically fees charged to allow the individual visitor or a company to carry out a specific activity that requires special supervision because:

(i) It is infrequently exercised;
(ii) Demand for this activity must be managed;
(iii) Controlling activity is necessary to minimize resource damage.

Examples of activities include: sport fishing, boat launching, anchoring of boats, and cruise ship visits. It is common for some of these types of activities to be rationed in order to reduce human impact and/or provide for a particular visitor experience such as solitude. It is a useful mechanism for monitoring how many visitors actually carry out certain activities. Guides and tour operators may also need special permits to work within the site, for which a fee is usually charged.





Other fees - There are other opportunities to collect fees which were not included in the above list and might be considered on a site-by-site basis. They include: Royalties on goods sold at the site, airport taxes, hotel room taxes, road tolls, cruise ship fee, scuba diving fee, fishing fee etc.,

**Step by step methodology:**

In this section we outline general steps for implementing a comprehensive Tourism User Fee Program. Two specific categories of TUF - entrance and concession fee - are initiated in the first phase. Other user fees could be brought on stream in later phases of the Program. It is important to note that precise sequencing and implementation of these steps will vary considerably, depending on many circumstances specific to the locality. It is also important to note that the steps outlined below (e.g. conducting an in-depth feasibility study) should be integrated into a broader tourism management plan.

Step 1:

- Conduct brainstorming sessions and draft papers on what types of user fees might be charged, how such revenues might be allocated, ways to evaluate the success of the user fee program, etc.

Step 2:

- Profile current tourists through existing data and tourist surveys, important elements of their visit, motivations for current and future trips, average expenditures, average duration of stay, tourist segmentation (e.g. mass tourism versus high-end tourism etc.), countries of origin, etc. This is done for entrance fee only.
- In conjunction with local tour operators, estimate current visitation rate and project future trends.
- Estimate the impact capacity at the site (i.e., what are the "limits of acceptable change"?)
- Assess existing ecotourism management plans and marketing plans, and identify elements for improving such plans.
- Building on any existing zoning, identify specific steps to develop / implement a visitor zone designation scheme, with varying levels of visitation and other use restrictions.
- Assess feasibility (e.g. revenue potential, consistency with MPA objectives, legal and regulatory issues, implementation feasibility, etc.) of a range of TUF, starting with entrance and concession fees.
- Assess implementation issues, such as funds management and distribution, participation in oversight bodies, etc.

Step 3:

- Issues to be discussed include: types of user fees to be employed, along with prioritization and sequencing of such fees and fee differentials; the need for any changes to the existing legal/regulatory framework; principles for implementing the TUF program; allocation of income, etc.

Step 4:

- Identify key areas of action: major services to be provided; allowed activities; fee rates and collection methods; necessary equipment, supplies, personnel, and installation efforts; administration policies; control systems; and evaluation methods.
- Identify specific steps to develop / implement an ecotourism marketing campaign to attract more visitors, if consistent with limits of acceptable change.
- Identify specific steps to ascertain appropriate fee prices, including:
- Calculate the cost of providing and maintaining recreational opportunities for visitors.
- Determine whether fees should be tiered (i.e. different rates on different visitor profiles).
- Gather information on fees charged at other similar sites nationally and internationally.
- Develop steps that address the site's liability responsibilities towards visitors.
- Prepare a revenue allocation plan, designating the use of revenues from TUF for various conservation projects or to cover more general costs.

Step 5:

- Determine how and where the fee will be collected (entrance gate, through tourist operators, etc.)
- Redistribute existing personnel or hire new personnel for fee collection. Purchase any necessary equipment and supplies. If needed, construct / install any new facilities needed for entrance fee collection, such as turnstiles and booths (Locate collection facilities, special attractions, and infrastructure to minimize impact on natural resources).
- Establish an accounting system to track and analyze fees being collected.
- Hire an independent firm to audit the site's accounts periodically.
- Led by appropriate tourism agencies, if appropriate, begin or expand ecotourism marketing campaign, in coordination with private sector.
- Be transparent about how the revenues will be allocated.

## 6.5. Cost Efficiency Issues

The goal of Marine protected area managers, as in other sectors, should be to spend less and achieve more. This includes: (i) balancing budgets and eliminating non-essential expenditure; (ii) sharing the costs and benefits of management with local stakeholders; (iii) putting in place incentives mechanisms for industry and local communities to reduce over-use and encourage protection; (iv) involving stakeholders in the direct management of the area through co-management with local communities, the private sector, NGOs and/or government; (v) encouraging these groups to invest in and manage some of the costs; (vi) making use of volunteers; and (vii) promoting biodiversity enterprise. This may also include compensating resource users for not exploiting the resource - in the long term this can be a more cost-efficient option than regulation and enforcement or rehabilitation.

**Incentive Mechanisms**: Although command and control mechanisms are often necessary in a protected area, positive incentive mechanisms, such as licenses and new markets, are more efficient ways to move resource users to more sustainable use of the resource. People are far more likely to conserve a resource if it is profitable for them to do so or if they directly bear the costs of degrading the environment. Incentive mechanisms should encourage positive reinforcement - in the case of MPAs, they should entice stakeholders (government, business, NGOs, local communities) to conserve marine ecosystems. Such mechanisms can be in the form of economic instruments or property rights, giving individuals or groups a sense of ownership over a resource - or clear responsibility for the exploitation of the resource itself. Property rights are one way of enabling stakeholders to directly bear the costs, as well as receive the benefits associated with the exploitation of the resource.

**Business Opportunities**: Alternative livelihood opportunities arising out of MPAs can be attractive to local communities and business. For instance, in the Caribbean, experienced fishermen are moving into the sport-fishing industry for much greater profits than from the case of over fishing. Boat owners are operating water taxis on a part-time basis, and water taxi associations are being formed to maximize benefits to individuals. These types of opportunities must involve sustainable use in order for them to contribute to the sustainability of the protected area. In turn, these business ventures must be dependent on a healthy environment in order for them to see the incentive of maintaining the MPA. For example, ecotourism enterprise revenues depend on a certain quality of the environment where they operate.

**Licenses**: Licenses that establish a form of property rights and encourage sustainable use, rather than only serving to collect revenue, act as incentive mechanisms. The longer the term of the license, the more likely the user will have a long-term interest in the area and therefore an incentive to use the resources in a sustainable way. Such instruments are particularly useful for outer lying areas, where it is more difficult for the government to enforce protection.

**Cost Sharing**: Cost-sharing mechanisms can range from sharing specific management responsibilities (i.e. communities involved in monitoring and enforcement activities and dive operators maintaining mooring buoys) to commercially viable partnerships with the private sector, local communities and NGOs.

In the case of the Great Barrier Reef Marine Protected Area in Australia, the private sector has become informally and indirectly involved in the management of the area (McNeill, 1994). Tour operators and other stakeholders currently play a variety of roles in the management of the park. Some examples include: resorts providing rangers, commercial fishers paying for dedicated access to moorings, dive operators trained to give evidence of non-compliant fishers, and involving Aboriginal islanders in the management of the reef (community-based rangers and managers of hunting permits).

In some cases a diversity of partnerships helps managers of many wildlife refuges to stretch their budget without having to seek further funding. For instance, they team up with state-level agencies for wildlife management and law enforcement and NGOs for management and research.

Volunteers are also a critical component to achieving management goals in MPAs. In addition to performing their duties at the site, volunteers often have an important role in the community, becoming ambassadors for the MPA.



ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

## 6.6. Other Issues in Financial Management of MPAs

**Compensation payments**: In some instances, compensation payments may be necessary to entice resource users over to new practices. For example, in Soufriere Marine Park (Sandersen and Koester, 2000) it was necessary to compensate fishermen for a limited period of time for their losses. These 'positive subsidies' enabled the fishers to sustain their income during the period of fishery replenishment. Compensation payments can also enable the user to move over to alternative livelihood options. Often the opportunity costs for not destroying the resources are relatively low, and compensation schemes or employment schemes are cheap investments for changing people's behaviors in favor of protecting the area.

**Diving Charge**: In some sites, managers are considering the option of charging divers according to the quality of the site. Experienced divers quickly notice a difference and are always keen to improve the quality of their experience; however, whether they would be willing to pay more is not guaranteed. In areas where artificial reef systems are being installed to rehabilitate reefs, managers are also considering whether they can raise additional funds to finance these projects by taking divers for an educational experience to a rehabilitation site for an additional charge.

**Limit use**: In some parks entrance is not dependent upon payment but on reservation. Therefore, it is operated on a "first come first serve base". The benefit of operating in a manner that doesn't involve payment is that it doesn't favor higher income visitors. The drawbacks are twofold. Firstly, there is no revenue generating mechanism hence, finance should be looked at other sources. Secondly, it is not guaranteed that those who are willing to pay the most are those who will enjoy the option to visit. The reason is that there is no linkage between willingness to pay and reservation at early stages of the season. The final outcome might result in a black market operation.

## 6.7. Case Studies

**Case study 1:** Economic Values for Montego Bay Marine Park, Jamaica

Ruitenbeek et al. (1999) made an assessment of Total Economic Value of Montego Bay Marine Park in Jamaica (table 6.2). In the first numeric column (under *Benefits*), the table shows the aggregate total values of the range of associated values in Montego Bay using the Net Present Value (NPV). In the second numeric column, the marginal benefits/costs of a percentage change in the abundance of the resource (e.g. quality of coral reef) are estimated. And in the last column, the marginal benefit of an additional hectare (or costs of the loss of a hectare) of the resource, under current reef conditions, is estimated. This demonstrates the importance of identifying the range of associated values in the MPA. The information can be used as an educational tool to assist policy makers, as well as a planning tool in the formulation of policies (such as investment in the protected area).



Table 6.2: Benefits at Montego Bay Marine Park

| | Benefit | Marginal Benefits* | |
|---|---|---|---|
| | NPV (MM$) | MM$/% | MM$/ha |
| Tourism/Recreation | 315.00 | 7.33 | 17.18 |
| Artisanal Fishery | 1.31 | 0.03 | 0.07 |
| Coastal Protection | 65.00 | 1.51 | 3.54 |
| Local Non-use | 6.00 | 0.24 | 0.56 |
| Visitor Non-use | 13.60 | .54 | 1.28 |
| Subtotal | 400.91 | 9.65 | 22.63 |
| Pharmaceutical Bioprospecting (Global) | 70.09 | 0.23 | 0.53 |
| Total (Global) | 471.00 | 9.88 | 23.16 |
| Pharmaceutical Bioprospecting (Jamaica) | 7.01 | 0.02 | 0.05 |
| Total (Jamaica) | 407.92 | 9.67 | 22.68 |

* Marginal Benefits shown at typical current reef conditions

Source: Ruitenbeek, HJ, M Ridgley, S Dollar and R Huber (1999). Optimization of economic policies and investment projects using a fuzzy logic based cost-effectiveness model of coral reef quality: empirical results for Montego Bay, Jamaica. Coral Reefs 18: 381-392.

**Case study 2: Revenue for MPA** Entrance Fees Charged by the Galápagos National Park

Galápagos National Park (GNP), a marine reserve off the shores of Ecuador, earns over US$5 million per year through user fees of various sorts. This is of high value to the government of Ecuador, and previously 30% of this revenue was reverted to the mainland. However, since 1998, the Special Law for the Galápagos has required 90% of this revenue to remain in the islands. Currently, 40% of the revenues are reinvested into the management of GNP, 5% goes directly to the management of the Galápagos Marine Reserve, 5% to the quarantine and control system, 5% to the Galápagos National Trust, 20% to the Galápagos municipalities, 20% to provincial local governments, 5% to the Department of Environment and 5% to the National Navy.

In order to achieve this high level of revenue, Galápagos National Park charges a high fee, particularly from foreign tourists. This fee reflects the high willingness to pay for entry to the park (table 6.3).

Table 6.3: Galápagos National Park's Fee System in US$

| Type of Visitor | Entrance Fee |
|---|---|
| Foreign Tourist | 100 |
| Foreign Tourist under 12 years | 50 |
| Foreign Tourist from the Andean Community or Mercosur | 50 |
| Foreign Tourist from the Andean Community or Mercosur under 12 years | 25 |
| Citizen/resident of Ecuador | 6 |
| Citizen/resident of Ecuador under 12 years | 3 |
| Foreign tourist non resident attending national academic institute | 5 |
| Tourist under 2 years | 0 |

Source: http://www.galapagosonline.com/nathistory/nationalpark/nationalpark.htm

**Case study 3: Cost-Efficiency Options** Sport Fishing Licenses Provide Large Incentives for Conservation in Cuba

About 50 miles off the southeast coast of Cuba, roughly a thousand square miles (about 26,000 km2) of reefs, mangrove swamps, and islands, are known collectively as Jardines de la Reina (the Garden of the Queen). This area is closely guarded and accessed by only a few Cuban lobster boats, foreign divers and light-tackle fishers. Strictly enforced government laws against poaching protect the area, but this is not likely to be enough to ensure the pristine state of the area maintained. Some essential protection comes from a public-private joint venture between the Cuban government and an Italian company named Avalon. The government has granted Avalon a license to operate a substantial catch-and-release fishing camp. This area boasts the finest fly-fishing in the world for bonefish. As a by-product, the permit system makes it in the company's best interest to ensure that nobody affects the area (Benchley 2002).

## 6.8. Summary

This section dealt with financial issues concerning the criteria and operation of MPAs. Without a solid financial plan, MPAs would always depend on governmental funds. Financial plans can help MPAs be independent and by that helping local communities who rely on those assets as preserved areas.

In order to achieve the stated goals of an MPA, there is a need to have plans. Those are divided into long, medium and short time spans. Each one should fulfill different achievements. For example, short time plans should be operational plans but long time ones should be more strategic.

Generating revenues should be thought of as means and not goals. They should try to achieve goals such as independency, carrying capacity, employment etc. Most of the tools are related somehow to fees, whether they are entrance fees, license fees, concession fees, diving fees etc.



However, it should be noted that not all MPAs can be subjected to business environment. Some MPAs can be subjected only to entrance fees but not to any other attraction built in their surroundings. This issue should be dealt with in the management plan before declaring the area as an MPA.

## 6.9. Further Readings and additional references

### Further readings

1) Katrina Brown, W. Neil Adger, Emma Tompkins, Peter Bacon, David Shim and Kathy Young (2001). Trade-off analysis for marine protected area management. *Ecological Economics* 37, 417-434.

This paper outlines an approach to natural resource management that incorporates multiple objectives for protected area management within a decision-making framework. Both regulators and other major stakeholders are directly incorporated into the approach to enhance decision-making processes, an approach called trade-off analysis. The paper applies trade-off analysis to the case of Buccoo Reef Marine Park in Tobago.

2) Mathieu Laurence F., Langford Ian H. and Kenyon W. (2003). Valuing marine parks in a developing country: a case study of the Seychelles. *Environment and Development Economics* 8: 373-390

A strategic issue facing many developing economies is the maintenance of natural resources, which are important in ecological terms as well as for providing income from tourism. This paper presents an analysis of the economic value of marine protected areas in the Seychelles. The contingent valuation method (CVM) is used to determine tourists willingness to pay (WTP) for visits to Seychelles' marine national parks. In addition, attitudinal and motivational data are related to respondents' stated economic preferences. The discussion focuses on exploring how this information may be of use to policy makers in setting a realistic pricing policy for visitors to Marine National Parks in the Seychelles.

3) Park Timothy, Bowker J. M. and Leeworthy Vernon R. (2002). Valuing snorkeling visits to the Florida Keys with stated and revealed preference models. *Journal of Environmental Management* 65, 301-312.

Coastal coral reefs, especially in the Florida Keys, are declining at a disturbing rate. Marine ecologists and reef scientists have emphasized the importance of establishing nonmarket values of coral reefs to assess the cost effectiveness of coral reef management and remediation programs. The purpose of this paper is to develop a travel cost - contingent valuation model of demand for trips to the Florida Keys focusing on willingness to pay (WTP) to preserve the current water quality and health of the coral reefs.

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## Appendix 6.1: Visitor Survey

Date _____ Interviewer _____
Survey No._____ Location _____

**1.** Please circle the appropriate number indicating whether you are completing this survey as an individual or as a couple or family. If you are a couple/family, please write how many people are in your family group.

1. as an individual
2. As a couple/family - there are _____ of us traveling together as a couple/family

(For the following questions, when we say "you" or "I" we are referring to your family group)

**2.** Next, we'd like to find out more about your current trip. By "trip," we mean the period from when you left your home (your usual place of residence) to when you will return there.

| How many days will you spend ... | Days |
|---|---|
| a. in total on this trip | |
| b. in [insert name of the region] | |
| c. in [insert the name of the country] | |





**3.** During the days you are spending in [insert name of MPA], are you traveling as part of a tour package (booked with an operator or travel agent), traveling independently, or some of both?

1. I am traveling as part of a tour package for the whole time in [name of MPA]
2. I am traveling independently for the whole time in [name of MPA]
3. For some of the time in [name of MPA] I am traveling as part of a tour package and for some I am traveling independently. Please write how many days you are spending:
   a. as part of a tour package _____ days and
   b. traveling independently _____ days

**4.** Approximately how much money will you spend in total for your time in [name of MPA]- including airfare (if you are flying to/from [name of MPA]), accommodation, food, souvenirs, and other expenses? If you are traveling as part of a tour package, include both the cost of the package and the cost of any items not included in the package - if the package covers travel both in [name of MPA] and elsewhere, please estimate how much of the cost is for the [name of MPA] portion.

Please specify the amount and currency (for example, local currency, US$, euros, _, etc.).

Individuals:

I will spend approximately: _____

Couples/families:

We will spend approximately: _____ per person
or
We will spend approximately: _____ total for _____ persons

**5.** In question 2, you wrote how many days you will spend in [name of MPA] and in [name of region] as a whole. In the following table, please write how many days in total during this trip you will spend in [the name of the MPA], how many days in other nature reserves or parks, and how many days in nature reserves or parks outside of [name of country]. (If you do not know the exact number of days, please write your best estimate.)

| Area | Days |
|---|---|
| a. [name of the protected area] | |
| b. Other nature reserves or parks in [name of country] | |
| c. Nature reserves or parks in other countries | |

In [name of MPA], the [name of country and park management agency] charges visitors [describe current entrance fee system]. The park management may decide to charge a higher fee - with money being used to improve visitor services and facilities. For example, the revenue would be used to build and maintain a visitor center, train local nature guides, etc.

This fee would increase the cost of your visit, as operators would add it to your tour price. We would like to know how this would affect your trip. Please assume that the fee changes only at [name of MPA] - not at other parks.

If the trip price had been [insert proposed fee increase] higher than what you paid, would you still have come to the reserve? (Please circle the appropriate number.)

Yes, I would still have come to [name of MPA].

No, I would not have come to [name of MPA]. (I would have gone elsewhere or not visited parks).

Lastly, we'd like to learn more about the characteristics of people that visit [name of MPA]. All responses are confidential, and we will not ask your name or anything else that can identify you.

For questions 7 through 10, please answer only for yourself, even if you are completing the survey as a couple or a family.

**7.** Where do you live (Please circle the appropriate number)? [Alter countries as appropriate]

1. United Kingdom
2. Germany
3. United States
4. France
5. Netherlands
6. Switzerland
7. Another country - please write the name of your country_____

**8.** What is your gender?

1. Female 2. Male

**9.** What is your age?

1. Under 18 years
2. 18 - 29 years
3. 30 - 39 years
4. 40 - 49 years
5. 50 - 59 years
6. 60 years or over

**10.** What is your highest level of completed education?

1. Primary school
2. High school (diploma)
3. Undergraduate college/university (e.g., Bachelors)
4. Graduate (e.g., Masters or Ph.D.)



**11.** What is your pre-tax income per year from all sources? Those answering as individuals should circle the number that shows their individual income. Couples/families should circle the number that shows their combined household income.

a. If you know your annual income in US$ (US dollars) or in € (euros), please circle the relevant number from this list:

1. Less than 20,000
2. 20,000 to 39,999
3. 40,000 to 59,999
4. 60,000 to 79,999
5. 80,000 to 99,999
6. 100,000 to 119,999
7. 120,000 to 139,999
8. 140,000 or above

b. If you do not know your income in US$ or €, please write the name of the currency and the amount in the following spaces:

Currency name: _____
Amount: _____

**Thank you for completing this survey! When you are finished, please hand the survey back to the interviewer.**

ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

# 7. Glossary

**Biological diversity (biodiversity)**
"The millions of plants, animals and microorganisms, the genes they contain and the intricate ecosystems they help build into the living environment" (WWF 1989).
The variety and variability, in number and in type, among living organisms and the ecological complexes in which they occur. Biological diversity contains three levels: Species diversity, genetic diversity and community diversity.

**Benefit-Cost Analysis (CBA)**
An analytical technique that compares the benefit generated by an activity with its opportunity cost of production. The rule is that if benefits exceed costs, then the activity is efficient and should be undertaken. In some cases the end result of benefit-cost analysis is net benefits, which are benefits minus costs. A positive value means the activity is efficient. In other cases the end result of benefit-cost analysis is a benefit-cost ratio, which is benefits divided by costs. A ratio greater than 1.0 is thus the indication of an efficient activity.

**Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**
A 1973 international treaty that binds over 100 countries to establish a system of permits for the exporting and importing of endangered species or products of organisms that are endangered. The CITES protected species list contains about 1200 plants and animals.

**Contingent Valuation Method (CVM)**
Directly asking people what they are willing to pay for a benefit and/or willing to receive in compensation for tolerating a cost through a survey or a questionnaire. Personal valuations for increases or decreases in the quantity of some good are obtained contingent upon a hypothetical market. The aim is to elicit valuations or bids which are close to what would be revealed if an actual market existed.

**Consumer Surplus**
The satisfaction that consumers obtain from a good over and above the price paid. This is the difference between the maximum demand price that you would be willing to pay and the price that you actually pay. For most consumers, under most circumstances, the demand price is greater than the price paid. Even competitive markets overflowing with efficiency generate an ample amount of consumers' surplus.

**Demand and supply**
A model that attempts to describe, explain, and predict changes in the price and quantity of goods sold in competitive markets.

**Demand**
The maximum quantities of a good that people will buy at different prices.

**Demand function / curve**
A graphic representation of the relationship between prices and the corresponding quantities demanded per time period; the relationship between quantity demanded of a good and the price, whether for an individual or for the market (all individuals) as a whole

**Discount rate**
The degree to which future dollars are discounted relative to current dollars. Economic analysis generally assumes that a given unit of benefit or cost matters more if it is experienced now that if it occurs in the future. The degree to which the importance that is attached to gains and losses in the future is known as discounted. The present is more important due to impatience, uncertainty, and the productivity of capital

**Discounting**
A mechanism which brings all future values of either benefits or costs into a common denominator of values stated in their present value form.

**Economics**
A social science that studies the allocation of limited resources to the production of goods and services used to satisfy consumer's unlimited wants and needs. Five notable phrases contained in this definition that need further study are: (1) social science, (2) allocation, (3) limited resources, (4) production, and (5) unlimited wants and needs.

**Endemic species**
A species that is native to a geographic area and is also restricted to that area or specific habitat.

**Externalities**
Costs or benefits which are not included in the market price of a good because they are not included in the supply price or the demand price. Pollution is an example of an externality cost if producers aren't the ones who suffer from pollution damages. Education is an example of an externality benefit when members of society other than students benefit from a more educated population. Externality is one type of market failure that causes inefficiency.



**Marginal cost (MC)**
The increase in total costs as one more unit is produced.

**Marginal willingness to pay (MWTP)**
The willingness to pay for an additional unit of the good.

**Market Economy**
A decentralized system where many buyers and sellers interact.

**Market equilibrium (market price)**
The price at which the quantity supplied and the quantity demanded are equal to each other

**Market failure**
Conditions in which a market does not efficiently allocate resources to achieve the greatest possible consumer satisfaction. The four main market failures are (1) public good, (2) market control, (3) externality, and (4) imperfect information. In each case, market acting without any government imposed direction, does not direct an efficient amount of our resources into the production, distribution, or consumption of the good.

**Marine Protected Areas (MPAs)**
Any area of the intertidal or subtidal terrain, together 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 of the enclosed environment" (IUCN, 1988;).

**Mediterranean action plan (MAP)**
The Mediterranean action plan (MAP) strives to protect the environment and to foster sustainable development in the Mediterranean basin. It was adopted in Barcelona, Spain, in 1975 by 16 Mediterranean States and the EC, under the auspices of the United Nations Environment Programme (UNEP). Its legal framework comprises the Barcelona Convention adopted in 1976 and revised in 1995, and six protocols covering specific aspects of environmental protection. A Mediterranean Commission for Sustainable Development was also established by MAP in 1995 to facilitate the participation of all stakeholders in the Mediterranean area.

**Maximum Sustainable Yield (MSY)**
The optimum rate of harvest to achieve a lasting amount of the resource.

**Net benefit**
A measure of desirability of a project or a program. It is done by subtracting the costs of the program from its benefits. A net benefit greater than 1 means that the project is desirable from a social point of view.

**Non-exclusivity**
The good (or resource) is available to everyone, like a panoramic view.

**Non-market values**
Goods that are not sold in the market place, like most environmental goods, and therefore the economic system fails to recognize their value.

ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

**Non-rivalry**
One person's consumption of the good does not reduce the amount available to others, like street-light.

**Non-use values**
The value which is inherent in the good itself, the satisfaction we derive from the good is not related to its consumption but to the fact we know it is there.

**Opportunity cost**
The cost of a resource, measured by the value of the next-best, alternative use of that resource.

**Present value of net benefits**
The present value of a future cash flow is the nominal amount of money to change hands at some future date, discounted to account for the time value of money. A given amount of money is always more valuable sooner than later, therefore present values are smaller than the corresponding future values.

**Present Value**
The value today of a sum to be paid or collected in the future to buy a good or service.

**Producer surplus**
The revenue that producers obtain from selling a good over and above the opportunity cost of production. This is the difference between the minimum supply price that sellers would be willing to accept and the price that is actually received. For most producers, under most circumstances, the supply price is less than the price received. Even competitive markets overflowing with efficiency generate an ample amount of producers' surplus.

**Property rights**
The right to own, use, consumes or sell an asset, or trade the right away in return for something else.

**Public goods**
A public good is one which, if made available to one person, automatically becomes available to all others in the same amount. A public good cannot be withheld from people even if they don't pay for it. There are relatively few pure public goods, but good examples are national defense and street-lights.

**Regression analysis**
Regression analysis is any statistical method where the mean of one or more random variables is predicted conditioned to other (measured) random variable. In particular, there is linear regression, logistic regression, Poisson regression and supervised learning. Regression analysis is the statistical view of curve fitting: choosing a curve that best fits given data points.

**Social Surplus**
The sum of Producer surplus, consumer surplus and any other stakeholder involved in the market or affected by it.



**Stakeholders**
Anyone - a person or an organization that has a legitimate interest in a project or entity. It actually includes everyone with an interest (or "stake") in what the entity does. That includes its vendors, employees, customers and members of a community where its offices or factory may affect the local economy or environment.

**Stated and revealed preferences**
Revealed preference approaches make use of individuals' behavior in actual or simulated markets to infer the value of an environmental good or service. These methods are also referred to as indirect or surrogate market approaches.
Stated preference method attempt to elicit environmental values directly from respondents using survey techniques, and are also referred as direct approaches.

**Supply curve**
A graphical representation of the relationship between the supply price and quantity supplied (that is, the law of supply), holding all ceteris paribus supply determinants constant.

**Travel Cost Method (TCM)**
A method that derives values by evaluating expenditures of visitors to a certain site. Travel costs are used as a proxy for price in deriving demand curves for the recreation site.

**The time value of money**
The time value of money is based on the premise that one will prefer to receive a certain amount of money today than the same amount in the future, all else equal.

**Total economic value**
The range of values that is associated with a natural resource which include all its use values and non use values.

**Use-values**
Benefits deriving from the actual use of the environment. Anglers, hunters, boaters, nature walkers, bird watchers, etc. use the environment and derive benefits.

**WTP**
The maximum amount of money one would give up to buy some good. It reflects the measure of satisfaction or importance of the good.

**Zonal TCM**
Concentric zones are defined around each site such that the cost of travel from all points in a given zone is approximately constant.

ECONOMIC ASPECTS OF MARINE PROTECTED AREAS

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## 8.1. Web Sites

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http://www.deh.gov.au/coasts/mpa/nrsmpa/global/volume1/chapter3.html

**Economic of Marine Resources site for the GEF Large Marine Ecosystems Structured Learning Community, IUCN:**
http://earthmind.net/marine/

**Galapagos on line - Galapagos National Park, Ecuador:**
http://www.galapagosonline.com/nathistory/nationalpark/nationalpark.htm

**Nature Parks, Reserves and Monuments of Slovenia Istra:**
http://dragonja.nib.si/Zusterna/

Parc National de Port-Cros, France:
http://www.portcrosparcnational.fr/patrimoine/images/fiche_flore_marine_posidonie.jpg

**Sharing the Fish - Toward a National Policy on Individual Fishing Quotas Committee to Review Individual Fishing Quotas, Ocean Studies Board, Commission on Geosciences, Environment, and Resources National Research Council, NATIONAL ACADEMY PRESS, Washington, D.C. 1999:**
http://books.nap.edu/html/sharing_fish/#Summary

**Wikipedia - Map of the Mediterranean Sea:**
http://he.wikipedia.org/wiki/%D7%94%D7%99%D7%9D_%D7%94%D7%AA%D7%99%D7%9B%D7%95%D7%9F

1 The marine biology content of this questionnaire is from:

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MAP

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