

The Economic Value and Impact of Three Marine Management Areas

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1 An Overview

Marine managed areas (MMAs) represent an increasingly used, spatial approach to maintaining and improving the ecological and cultural integrity of critical marine habitats. These areas also have the potential to generate substantial economic benefits and to reduce conflict around resource use. Some of the benefits of MMAs accrue directly to those who use and visit MMAs and also to businesses that cater to these users. Other benefits are enjoyed indirectly through the contribution of MMAs to ecosystem health and services, shoreline protection, open space, and even to extractive activities (e.g. fishing) outside of the protected area. While these factors alone could justify significant government investment and involvement in MMAs, they are rarely considered directly by policy makers charged with establishing and supporting MMAs. One reason for this failure to incorporate more human values in these decisions is the general lack of data and understanding about how marine management affects these values, an information gap which means that it is difficult to compare the effectiveness of MPA funding with other uses of public funds. Without these data, financial investment in MMAs is likely to fall short of optimal and managers will not fully understand the economic impacts of their management decisions, which could have far-reaching and unintended consequences on food, income and employment for many people.

In this report, we examine the economic value and impact associated with tourism and fishing in three marine managed areas: Abrolhos National Marine Park (Brazil), Coiba National Park (Panama), and Gladden Spit and Silk Cayes Marine Reserve (Belize, herein referred to as GSSCMR). We start with a discussion of economic value and impact – what they mean and how they differ. In later sections, we synthesize recent research from these MMAs with special attention given to the estimated economic value and impact of each of these areas. We highlight ways this information can be used to better manage these important marine areas.

1.1 The Value of Marine Management Versus the Value of Marine Managed Areas

To begin to better understand the economic value and impact of MMAs, it is important to disentangle the economic value of the resource being managed and the management

itself. We generally assume that marine management is required because, in the absence of active management, habitats and resources would be degraded by human activity. From an economic perspective, this means that the value of protection is the difference in economic value WITH protection compared to what it would have been WITHOUT protection (Figure 1). For instance, assume that the annual economic value of a particular MMA, measured as profits for local tourist operators that use the area, is \$1 million. This reflects the economic value to these tour operations of being able to offer trips to the area. If the area is unmanaged (or poorly managed) it may be degraded and the profits earned by these tour operators could fall to \$400,000/year. The value to these businesses from sound management would be the difference: \$600,000/year. Of course, in practice, these differences are not realized right away. Initially, the difference in value with and without marine management may be small, but could grow larger over time. From the perspective of current generations, the ones making the decision to manage marine areas now, the economic value of future differences (with and without marine protection) matter less than ones in the near future. Economists must weigh the costs of establishing MMAs and the annual costs of operation against these future costs and when they do, they discount future values to reflect society's preference for results that can be felt sooner rather than later. We will not enter into a discussion of how economists discount future values, but simply note here that the timing of these differences is important - MMAs that avoid degradation that could happen quickly tend to be more valuable than MMAs that avoid degradation that is less imminent.

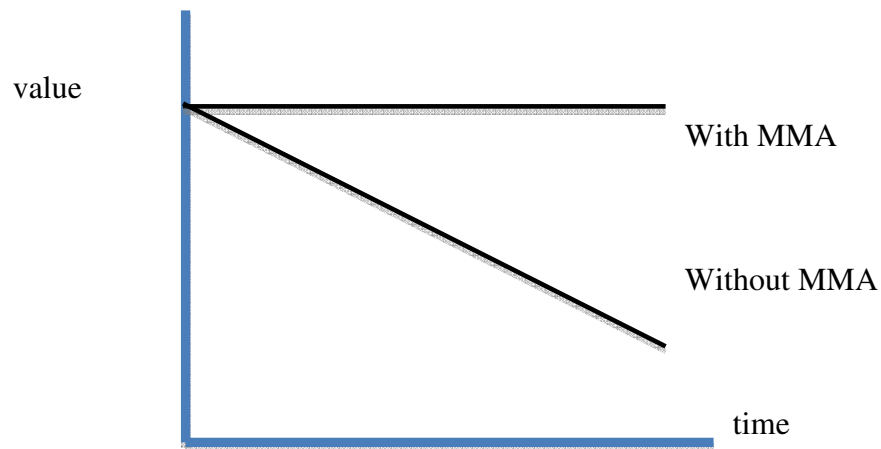


Figure 1: The Value Added of an MMA

Estimating the economic value of a marine area with and without management requires data collected over time at sites with and without management. This sort of data is rarely available. We could make educated guesses about the potential difference in these values

with and without management, but doing so requires a great deal of faith and imagination. If we were to use data to estimate the value of management, we might take one of two approaches. First, we could create models that link management to the condition of resources and the condition of resources to economic values and impact. The model would require data in order to calibrate its estimates – that data could come from the literature or nearby research sites. We also could collect local data before and after management is implemented. Additionally, we may want data that are collected in areas that are not managed. If we collect data only before and after management in our MMA, then it may be hard to tell whether management or some other factor (e.g. changes in the regional economy) was responsible for changes in uses. If we collect data in areas with and without management, but not over time, then we may not know whether the difference in value is the result of management or whether managed areas were already more valuable to begin with.

In most cases, including the MMAs examined here, we start without any data or any credible models. The best we can do in these instances is to begin to develop a baseline for economic value and impact – one that reflects value and economic use today. This information gives us an understanding of the maximum potential value or impact that would be lost with complete degradation (or loss) of the resource and it shows us the base value that could be improved through better management.

In this study, we focus on direct estimates of the economic value and impact of three marine managed areas in Belize, Brazil, and Panama. By direct estimates, we mean economic values and impacts for which we could collect our own data. There is a substantial and growing literature on the economic values and impacts of marine areas around the world. The three areas in our study, however, were chosen in part because of their uniqueness. This uniqueness makes finding similar examples from the literature difficult, but perhaps not impossible. We leave this literature review and the transfer of benefits from other sites for a future project and instead discuss our data, our findings, and how these baselines can be used to improve the management of these important marine areas.

2 An Introduction to Economic Value

Everyone thinks they understand value. After all, value is part of everyday life. There are spiritual values, religious and moral values, good values on used cars, and the list goes on. When the person on the street talks about the value of the ocean or reef or even an historic building, they might be talking about any of these values. When economists speak of value, however, the definition is much more narrow. For economists, **value**

represents how much the use or enjoyment of a resource improves the **economic well-being** of one person or of society at large.

For economists, the economic well-being generated by nature is an amalgam of values known as Total Economic Value¹. Total economic value includes the value we place on goods that we can use directly (use value), the value we place on goods we use only indirectly (indirect use value), and even the value we place on goods we may never use (non-use values). Use value includes the value we place upon fish we catch, trips to the beach, or the ability to see wonderful seascapes and mangroves. In order for an MMA to have a high use value, it must be used. Marine areas that are remote or in areas that are sparsely populated usually have small use values.

Coasts, oceans, and other habitats also produce many goods and services that we do not use directly (indirect use values), but which support the production of things we do use. For instance, sea grass habitats provide a nursery for many types of the fish we eat. Coastal forests may act to reduce bacterial contamination of runoff and in doing so provide clean water for swimming and snorkeling. Mangroves also draw carbon from the atmosphere (as carbon dioxide) and sequester it under water, reducing the most abundant greenhouse gas (GHG). These indirect use values may be enjoyed far from the marine managed area.

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Many people also value coastal and marine habitats even if they never plan to visit these places or use the goods and services they provide. Some people would pay to protect a coast and its inhabitants just to know it exists. Other people might place a value on knowing that a particular species exists (e.g. whale sharks). This non-use value is called an existence value. People may also be willing to pay so that they may have a future opportunity to enjoy a habitat and its many benefits (option value) or so that future generations have this opportunity (bequest value).

2.1 Measuring Economic Values

It is one thing to identify coastal and marine economic values, but another thing entirely to estimate these values. As a start, economists attempt to measure economic value by

¹ See <http://www.csc.noaa.gov/coastal/economics/envvaluation.htm> for a discussion of total economic value.

estimating the maximum members of society would pay to use a resource minus the actual cost of providing access to that resource. Why is this a measure of economic well-being? Consider the vernacular meaning of “a good value” which usually is taken to mean that you paid a lot less for something than you thought it was worth. Imagine you grew up in coastal Panama, but now live in Miami. When you lived in coastal Panama, you were able to buy snapper caught at Coiba for just \$2/kilogram. The same kilogram of snapper in Panama City would cost \$3/kilogram. At the time, that seemed expensive, but now that you live in Miami that snapper might cost you as much as \$20/kilogram. The higher cost is understandable. These snapper have to take a long truck ride to end up in Panama City and a plane ride to get to Miami. You may be willing to pay this higher price for snapper in Miami. If you are willing to pay \$20/kilogram, then you might think that the snapper in Panama City is a bargain! In other words, \$3 snapper has value to you because you would have paid a lot more, but did not have to at the time. Of course, \$20/kilogram is more than some people are willing to pay – the cost of buying Panamanian snapper exceeds the benefit some people in Miami would derive from eating it.

For economists, the term value comes from the idea of value added – the amount society benefits from something beyond what it costs society to make it, provide it, or protect it for use. Value is thus not the same thing as price. People buy goods or services in the market as long as their maximum willingness to pay for those goods or services is greater than the private cost, which for the consumer is the price times the quantity purchased.

For everything people consume, enjoy, or use in some way, there exists a relationship between the maximum amount someone would be willing to pay each time to consume a good or enjoy an activity (e.g. snapper or going to the beach) and the number of goods or times they participate in this activity (e.g. kilograms of snapper bought each year or the number of trips to the beach over the summer). Economists call the willingness to pay for one more of something the marginal willingness to pay (mWTP) and the total amount consumed or enjoyed is the quantity demanded (Q). The relationship between mWTP and Q is given by the demand function (Figure 2). We can estimate real demand functions, for snapper say, by looking at how much people buy when snapper is available at different prices. (When we add this up across all consumers, we get a market demand function). Almost without exception, the more we consume of any good or activity, the less we are willing to pay for one more chance to enjoy it. At some point, you just can't eat any more snapper and at that point your willingness to pay for another kilogram is zero.

Of course, snapper is not free and so we rarely have the luxury of eating until our hearts are content (also known as $mWTP=\$0$). Harvesting snapper is costly. The cost of

providing additional snapper for the market climbs as the number of fish brought to market increases because it gets harder and harder to find snapper (this marginal cost of snapper is represented by the supply function of Figure 2). These costs reflect the real cost of getting snapper from Coiba to the table and include the cost of fuel, vessel maintenance, labor, transport, and delivery. In all cases, society has hundreds of other ways in which this energy and equipment could have been used. When we apply these “factors of production” to snapper harvesting we are taking these factors out of other sectors of the economy. In the market place, the cost of these goods reflects not only the costs of production, but also the economic value of these inputs had they been used elsewhere in society (opportunity cost). For instance, consider that the fuel put in the fisherman’s boat could have been used in a bus to transport tourists. From society’s point of view, the use of that fuel to provide a little more snapper to the market generates more added **value** than would one more bus ride available for tourists. In fact, the market guarantees that snapper are only brought to market if the private value from buying and eating snapper is greater than the private cost of catching, processing, and shipping the snapper. People continue to buy and catch snapper as long as at least one person is willing to pay the costs of catching that last snapper and getting it to market. After that point, it is in no one’s interest to bring more snapper to market; consumers will not pay the increased cost, snapper fishers will not sell for less, and society would be worse off if more time, energy, and money were invested in catching more snapper.

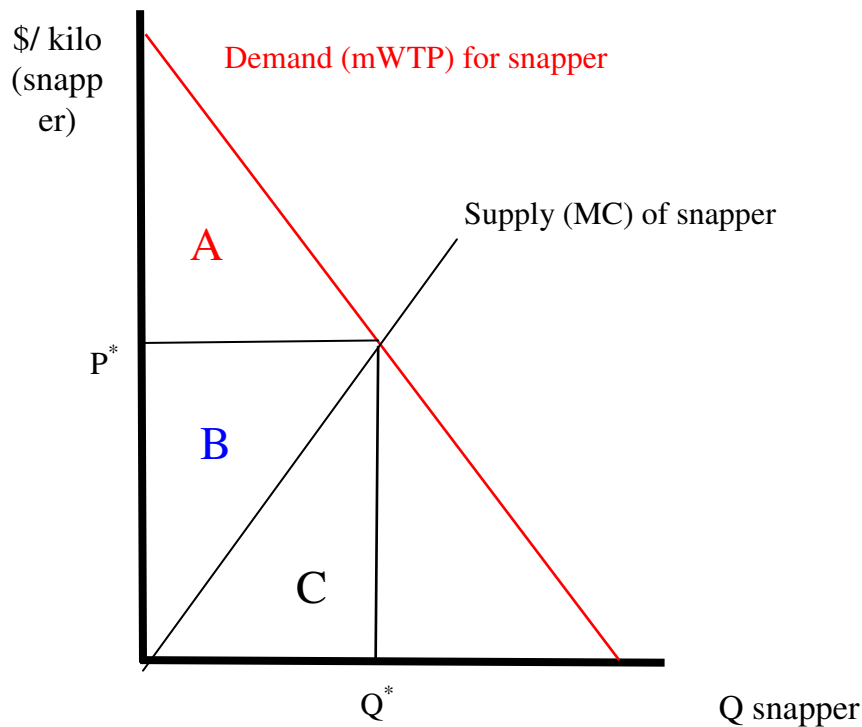


Figure 2: Supply and Demand of Snapper

The difference between the maximum that people would be willing to pay for something and the cost of providing that thing is economic value. In Figure 2, the demand function represents how much society would be willing to pay for each unit of Q if we could somehow make them pay for each unit as it is consumed. The area under the demand function ($A+B+C$) represents the maximum amount society would be willing to pay for Q^* (if they had to pay). The supply function represents how much it costs producers to produce each unit of Q if we could somehow track the cost as production increases (marginal cost or MC) and the area under this supply function (C) is the total cost of production. Following the logic we outlined above, economic value is the maximum willingness to pay minus the cost of production (areas $A+B$). In a market where Q^* is sold at price P^* (where P^* is the market price of snapper and Q^* is the total amount of snapper purchased), the consumer enjoys a value equal to area A (the consumer surplus) and the producer enjoys a value equal to area B (the producer surplus, a concept very closely related to profit).

*Figure 2 tells us at least three important things we need to keep in mind when thinking about the value of MMAs. **First**, spending, and thus revenues, associated with marine and coastal economic activities sets an upper bound on producer surplus, but tells us nothing about consumer surplus and thus nothing about the economic value of these activities. **Second**, people enjoy a greater benefit from something when they can get it cheaply or free. In some places marine resources can be enjoyed at little or no cost, especially to local users, while non-residents and tourists have to pay to travel to use these areas. As a result, these local users often enjoy a very large economic benefit from the enjoyment of marine goods and services, even if they don't spend much to do so. It also is true that many coastal and marine economic activities that generate few revenues still generate significant economic value (e.g. bird watching and beach going). **Third**, in a well functioning market, where producers and consumers can choose when to sell, the market achieves a balance that maximizes economic value. When a market does not exist for something, there is no reason to believe that society will provide the best level of access or use of that resource. When marine goods and services fall outside of the market, we should be concerned that the access to these resources may not be socially optimal (and in virtually all cases is well *below* the social optimum). This is exactly why we have public parks – the free market will neither provide nor protect enough habitat, cultural resources, or historical sites.*

<p style="text-align: center;">WHEN A MARKET DOES NOT EXIST FOR A RESOURCE (E.G. AN ECOSYSTEM SERVICE), SOCIETY WILL GENERALLY PROVIDE TOO LITTLE ACCESS, USE, OR PROTECTION.</p>
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In practice, measuring the economic value of products is not straightforward and so data regarding the economic value of marine and coastal goods and services are rare in many parts of the world. In the absence of data on value, economists tend to fall back on market prices and expenditures (or revenues). In Figure 2, the gross revenues for snapper (known as the landed value when measured at the dock) are given by the areas (B + C) or ($P^* \times Q^*$). This value is not consumer surplus (area A) nor is it the producer surplus (area B), and so these gross revenues do not reveal the full contribution that snapper harvesting makes to the well-being of society.

<p>CONSUMER SURPLUS ONLY BENEFITS THE LOCAL ECONOMY IF A GOOD OR ACTIVITY IS USED OR ENJOYED BY LOCAL RESIDENTS.</p>

We generally refer to the gross revenues and expenditures produced by MMA-related activities as **economic impacts**. These impacts are important because they give us an idea of how much currency is being moved through the local economy because of an activity. Money moving through the economy supports jobs and helps create a source of local tax revenues.

A focus on gross revenues and expenditures places a great deal of attention on marine activities that produce marketable goods while other activities (say subsistence fishing or beach going) may go unquantified, and thus unappreciated, from an economic perspective. As a result, too much attention may be given to the provision of marketed goods and too little attention given to other, non-marketed but economically valuable activities. As we discussed before, many of the resources that are managed in MMAs may be free or available at relatively low cost but could have extremely high value. Since expenditures are not necessarily indicative of value, development that favors marketed goods at the expense less-marketed goods may not be in the best economic interest of society.

Many marine goods and services are not marketed because they cannot be captured and sold directly in the market. For instance, consider fishing at a public dock or swimming at a public beach. In both cases, local laws or customs may make charging for access impractical. In other cases, marine goods and services may simply defy capture and sale; think of oxygen produced by the ocean, sea views, and or the shoreline protection provided by a coral reef. When there is no mechanism to permit the capture and sale of something it is said to be non-exclusive. Furthermore, a good may not be marketed because it cannot be made “private.” When a good or service is non-exclusive and the enjoyment of that good by one person does not preclude or affect the enjoyment of that same good by someone else, we say that good is a “public” good.

Coasts and oceans provide an unusually large number of economic goods and services that are difficult to introduce into the market place. Many of these difficult-to-market marine goods are entirely public in nature. As a result, a failure to understand the economic value of these goods and services impairs our ability to appropriately manage the coast and ocean for the best economic outcome.

2.2 Economic Impact

While economic value reflects the value added to society of an activity, many policy makers also are interested in the economic impact of an activity. Economic impact analysis measures the flow of money through an economy. It shows how much money, jobs, and taxes are generated by an activity. For example gross revenues from sales of snapper support jobs, local businesses, and form the basis against which taxes could be levied. While gross revenues do not provide any information about economic value, these figures are important because they are easily measured and provide a good starting point for understanding the economic contribution snapper make to the local economy, especially the tax base. Employment and wages also represent economic impacts of an activity.

Economic value and economic impact cannot be compared directly. Without appropriate research, it is difficult to know how much of gross revenues can be considered economic value. Even though economic value and impact are not comparable, comparisons are often made. The reason for this is simple: much of the debate about marine management comes down to jobs and revenues vs. the environment. When we compare economic impact to economic value we automatically put the non-commercial users at a distinct disadvantage against businesses; economic revenues always overstate the economic value to the producer. Nevertheless the non-commercial economic value of coastal uses can be very high.

2.4 The Link between Ecological Condition and Economic Value

From an economic perspective, MMAs are natural factories that produce things that people want: whales, whale sharks, diving and fishing opportunities, and fish for commercial fishers, to name a few. More accurately, it is the ecosystem within the MMA that creates the ecological and environmental products people demand – landscapes, seascapes, fish, and marine mammals.

Like industrial factories, the economic value of what the MMA produces depends on the quality of the product, the quantity produced, and the cost of production. For these ecological factories, certain ecosystem attributes are the final product. In Gladden Spit, whale sharks are the final product; in Abrolhos it's whales, and in Coiba it might be beaches. The ecological condition of these final products influences how much of the product the visitor enjoys and the quality of that product – for instance more and bigger whales.

It also is the case that many parts of the ecosystem are simply intermediate goods that contribute to other economic activities – MMAs may be home to mangroves that act as nurseries for fish caught hundreds of miles away, plankton are consumed by whale sharks, corals produce the sand that creates the beautiful white beaches of Coiba. The ecosystems that lie within MMAs also contribute significantly to numerous other ecosystem services that may not find their way into markets – including the production of oxygen, the sequestration of carbon, the provision of biological and genetic diversity, and even cultural and spiritual services.

Healthy ecosystems may produce more intermediate and final goods. Healthy ecosystems also may improve the resilience and sustainability of the production of these goods. In this report we attempt to identify the economic value associated with the direct use of the ecosystem goods that support tourism and fishing economies in and near these parks. These values depend directly on ecological conditions to the degree that these conditions influence the quality, quantity, and sustainability of these products.

While we do not attempt to estimate the affect of ecological change on economic values, a number of methods have been designed to do so. These methods include models of the way ecological change affects change in the productivity and value (profits) of businesses, farms and fishers (known as the productivity change methods). Other methods attempt to value directly how ecological change affects the consumer surplus people place on the consumption and enjoyment of goods, services, and activities. These methods include a variety of approaches sometimes referred to as demand function approaches since they estimate changes in the demand for goods and services (see Figure 2). Commonly used demand function approaches include travel cost methods, contingent valuation, contingent ranking and other stated preference methods, most of which rely on some sort of survey.

3 The Economic Impact and Value of Fishing and Tourism in MMAs

Marine managed areas have not typically been sited based solely on the high economic potential of the resources to be managed. In fact, many marine managed areas were created because of a combination of biological significance, imminent degradation, and chance opportunity. We consider three MMAs that each support at least two important economic activities - commercial fishing and tourism: Abrolhos National Marine Park (Brazil), Coiba National Park (Panama), and GSSCMR (Belize).

While the MMAs of Abrolhos, Coiba, and GSSCMR all share fishing and tourism as common uses, they provide three very different perspectives on the factors that contribute to the ultimate importance, value, and success of these activities. We provide a brief overview of the basic values and impacts associated with fishing and tourism in these parks, but spend more time trying to understand why these values differ. For fishing, we examine the economic value that fishing provides to local fishers and processors. We also estimate the economic value of tourism to both the tourist and the local businesses that provide tourism opportunities. The distinction between tourists and locals is important. Values enjoyed by tourists do not improve local welfare unless they can be captured somehow - through higher park user fees or contributions to the MMA.

The reader is directed to the original technical reports for more specific details about these values and figures.

3.1 Commercial Fishing

Fishing has long been a cornerstone of coastal economies. In order for commercial fishing to be economically important, a number of social, biological, and geographical elements must come together. First, there have to be abundant fish and shellfish (herein referred to as simply fish) stocks. Second, there needs to be some market demand for these fish. Third, the market must be accessible. Fourth, the fish must be accessible, which means that costs of production are low. And fifth, depending upon the value and quantity of fish landed, it often helps for fishing villages to be near markets and fish. Small scale producers rarely enjoy the economies of scale that allow some fisheries to ship fish across the world for processing.

MMAs can be designed to maximize the natural productivity and sustainability of sources of commercially important fish stocks. To some limited extent, marine management can

even influence the relative abundance of certain species over others (e.g. commercially important species versus less important species.) MMAs, however, can do very little to influence the market and geographic conditions of the fishery.

Importantly, MMAs are unable to control the costs and benefits of harvesting these fish and getting them to market. As a result, MMAs that are remote – far from fishers or far from markets – are at an economic disadvantage in terms of use value. Remoteness from villages means that the costs of fishing are high – these costs include the high cost of fuel and time to fish, the high cost of transport to market, potentially higher risks to fishers, and finally the social costs associated with having fishers away from their families for long periods of time.

3.1.2 Commercial Fishing and the Local Economy

Of all of the MMAs we examined, Coiba is the most remote. The park is far offshore making it remote from the handful of coastal villages that serve as fishing ports for those fishing the waters in and near the park. These villages are themselves far from their principal markets. Processors located in these villages sort and clean fish brought to the dock and immediately ship 80% of the catch to Panama City for export to Miami.

While the Coiba fishery supports 275 direct fishing jobs on 49 boats, and generates nearly \$7.5 million in gross revenues, the high cost of fishing means that the net economic contribution locally is only \$1.3 million in producer surplus – a return of 17% (See Table 1). Still, these are important jobs for a region with limited economic opportunities. Fishing crew earn almost \$1.3 million in total, with the mean monthly income for fishing families reported to be twice that for the average household in the region (\$332 compared to \$150/month).

Belize is a small country and its coastal population mirrors the low density of the Belizean population. While there are no estimates of the number of boats or fishers plying the waters near Gladden Spit, Hargreaves-Allen estimates that in 2007, almost 3,500 fishing days (it was not possible to estimate the number of different fishers involved) were spent fishing the waters in the MMA. Unlike Coiba, locals accounted for only 33% of the boats and only 12% of the number of fishers fishing inside the reserve, as many of them have switched to tourism-related activities, while migrant fishers from the North accounted for the vast majority of fishing effort. Fishing effort at this reserve is reduced and during spawning aggregations, a special license must be paid for, which only certain people are eligible for.

Because of the small size of Belize, and the close proximity of fishing grounds to the coast and markets, the net producer surplus estimated for the fishery supported by the

waters in and near GSSCMR is a large proportion of the total revenues associated with fishing. Hargreaves-Allen estimates that the regional fishery generates \$3million annually in gross revenues, and \$2.5million in net revenues – a return of more than 80% (compared to only 17% for Coiba)². Generally, fishers in this area were thought to have a mean producer surplus of US\$20,000 per fisher per year, although these estimates are based on fishers who use the reserve, which we expect to be more profitable than those who do not. The share of these profits that result from fishing within the reserve alone is almost US\$400,000 each year, of which \$51,000 goes to local fishers, and \$344,000 goes to migrant Sartenejan fishers. The relatively high profitability in this fishery is likely to be due to low costs of fishing for Sartenejans, who sail using the wind and carry up to 20 fishers per boat, so that costs per person are very small, as well as the limited access to spawning aggregations that local fishers enjoy and the reduced pressure due to the shift from fishing to tourism in the closes villages, which is why local fishers make the expensive journey out during these times and rarely otherwise.

In Bahia, Brazil, an important coastal fishery depends importantly on access to the waters near Abrolhos National Park. This fishery benefits from a substantial coastal population and a large fishing fleet of at least 154 boats. Despite, the high value of fish landings, costs of operating vessels (e.g. fuel costs) in the Abrolhos area were relatively high compared to Gladden Spit, yielding only 23% profits.

Table 1: The Annual Economic Impact and Value of Commercial Fishing

	Abrolhos National Park (Region)	Coiba National Park (Region)	Gladden Spit and Silk Cayes Marine Reserve (Region)	Gladden Spit and Silk Cayes Marine Reserve (within reserve)
Gross Revenues: Fishing	\$7.2 million	\$7.5 million	\$3.0 million	\$512,000
Net Revenues: Fishing	\$1.65 million	\$1.3 million	\$2.5 million	\$394,000
% Profits	23%	17%	83%	77%

² It is possible that estimates of profitability in this fishery are slightly inflated due to data limitations on vessel operating costs.

3.1.3 Value Added in the Fishing Industries

There have been many attempts to increase the value of extractive industries by promoting the local processing of fish (or in the case of forest communities, timber). In Coiba, Montenegro estimates that only \$0.18/kg (or roughly 8% of the landed value) goes to processing jobs. With the average port near Coiba landing only 65,770 kg of fish annually, the average value of processing-related jobs amounts to just under \$12,000 per port.

Value added in the fishery is constrained on two ends. At one end is the cost of catching fish. Fishermen cannot bring fish to the dock for less than the cost of harvesting. At the other end, the processor cannot sell fish for more than the market price. Squeezing the value added from both ends is the cost of transportation. If market prices are high and harvesting, processing, and transportation costs are low, there are profits to be made in processing fish. In situations where the costs of fishing are high and markets are distant, like those in Coiba, there is limited profit to be made in processing and thus processing tends to be minimal – focused on sorting and preparing the fish for transport to market.

3.1.4 The Relationship between Marine Management and Fisheries

The relationship between marine management and fishery production is contentious. Marine protection, a form of marine management, often results in the prohibition of fishing in some or all parts of the protected area. If the protected area includes nurseries or if fish within the protected area migrate outside of that area, then protection can lead to increased catch in areas outside of the protected area (a phenomenon known as spillover.) Spillover, however, is not guaranteed. For instance, consider a protected area that encompasses an entire reef. Without reef habitat outside of the protected area upon which to fish, the harvesting of reef species could be locally excluded.

In many cases, it is possible to design protection within an MMA to maximize the effects of spillover. Fishers throughout the world are known to “fish the line,” fishing as close as possible to protected areas. Near the Gladden Spit and Silk Cayes Marine Reserve, Hargreaves-Allen reports that fishermen had mixed views of how beneficial the reserve was to fishing success. Sixty-one percent felt that the catches were best near the no-take zone. Thirty-nine percent felt that the reserve had initially had a negative effect on their income. Still, 97% of the fishers interviewed thought that reefs needed to be protected. Generally, people supported the idea of protecting fisheries, but many thought management was undermined by poaching.

In the three MMAs examined here, it is clear that fish and shellfish harvested within the MMAs have real economic value and contribute to local economies. Integrated ecological and economic research is needed to show definitively that marine management actions affect these values.

3.2 *Tourism*

To have high tourism values, MMAs need to be accessible and offer something tourists want to see or experience. In some cases, an MMA can be remote and still be highly visited if the natural offerings of the MMAs are unique and charismatic. Remote MMAs, however, will always suffer from the fact that, all things being equal, high travel costs reduce the amount of money tourists spend locally.

For international visitors, there are two important components to the cost of travel: 1) the cost from the origin of residence to the country in which the MMA is found and 2) the cost of travel from the port of disembarkation to the MMA. All of the MMAs are remote from the major markets of the United States and Europe, with Brazil being the most remote of the three countries considered. All three MMAs are remote in the second sense as well, with Coiba being the most difficult MMA to access because it requires a boat trip from one of the out-of-the-way port towns in the Gulf of Chiriquí.

Additionally, the reputation and renown of the MMA is an important determinant of tourism demand. The Coiba National Park is relatively new and all three MMAs could improve visitation simply through better advertising and awareness campaigns.

Because of these factors, the number of foreign visitors to these sites is relatively small. There are almost no international tourists to Abrolhos National Park.

3.2.1 Making Public Goods Private: Park Fees, Concessions, and Accommodations within the MMA

Most MMAs are established to protect areas that are rare, if not unique, and often overused. MMAs also are established to halt or reverse the perceived decline in ecological and economic value associated with open access and overuse. To protect and manage marine resources, the MMA must establish jurisdiction over the resources and control its use. In a sense, the public owner of the resource (usually the national government), now becomes more like a private owner (of the MMA), one that can restrict use and even charge for use.

All three MMAs in this study collect entrance fees – generally less than \$20/visit. The fee for Abrolhos is a flat fee. GSSCMR charges separate fees for entering the park and for whale shark trips. Coiba has the most elaborate system of price discrimination charging different fees for nationals and foreigners, but also differentiated fees depending on the activities undertaken, whether one is a student or a senior citizen, and even differentiates by length of boat for the fee charged to anchor in the park. Perhaps because of the highly differentiated scale used by the Cobia National Park, the park raises significantly more in entrance revenues than the other parks (See Table 2).

Table 1: The Economic Value and Impact of Tourism

	Coiba National Park	Gladden Spit and Silk Cayes Marine Reserve (Region)	Abrolhos National Park
International Visitors	4,766	6,253	<50
National Visitors	2,063		~5000
Jobs	50	1206 days of full-time work	
In-country, trip-related expenditures	\$4,237,000 (by internationals)	N/A	\$7,181,323 (by Brazilians)
# of tour operators	11	23	<2
Producer Surplus of Tour Operators	\$55,000	\$678,000	
Park Fees	\$125,000	\$50,000	~\$25,250
Consumer Surplus for Park Entrance	\$20,200 for internationals, \$6,600 for nationals	\$60,000 (plus \$20,000 for whale shark trips)	~\$25,250 (based on median values)
Producer Surplus of Accommodation	\$34,000		
Net Annual Economic Value of Park Visitation	\$234,200	\$788,000	\$50,500

Coiba has used its unique “ownership of access” to also offer the only accommodations that are available within the park boundaries. The current demand for these accommodations generates a small producer surplus on the order of \$34,000, but it is likely that this visitation could grow substantially with a modest investment in infrastructure. Montenegro estimates that this producer surplus could easily exceed \$100,000/year with an investment of approximately \$150,000 over three years. Other national parks around the world, including many national parks in the United States, also have accommodations within the park. In most cases, though, the accommodations are run by concessionaires who bid for the opportunity to operate a hotel or restaurant. Through competitive bidding, the park is able to secure much of the expected producer surplus that could come from offering accommodations.

3.2.2 Local Spending by Tourists

From an economic perspective, international visitors to MMAs can bring new revenues into a country, but only if these visitors would not have come to the country if not for the MMA. If the MMA is not the primary reason for the trip to the country, these expenditures might have been made elsewhere in the country. That is, if Coiba draws tourists away from Panama’s San Blas Islands, visitation to Coiba may not generate new income, and thus economic impact, for the country. Similarly, it is likely that the expenditures made by the many Brazilians who visit Abrolhos might have been made elsewhere in Brazil, if they were not spent in conjunction with a trip to the marine park.

Montenegro estimates that foreign tourists to Coiba National Park spend a weighted average of \$889 (per person per trip) on local expenditures or a total local expenditure on the order of \$4.2 million annually. Of course, many of these expenditures cover the basic costs of providing the tourism experience – fuel costs, food, ice, and business or park infrastructure. With all of these costs netted out, Montenegro estimates that the park still contributes more than \$234,000 annually in producer surplus – a figure that is likely to rise as the popularity of the destination grows. For GSSCMR, Hargreaves-Allen estimates that tour operations earned more than \$1 million, of which \$678,000 was producer surplus. In Brazil, there are few international visitors to the Abrolhos National Marine Park, but Brazilian tourists spend as much as \$7 million in trip related expenditures. These expenditures represent local economic impacts, but may come at the expense of spending that would have taken place elsewhere in the country. (Estimates of the producer surplus associated with tourism expenditures associated with the Abrolhos MMA were not provided.)

The key to increasing the net benefit of MMA-related local expenditures is to increase how much money stays locally. That means reducing the proportion of imported factors

in the production of tourism services – for instance fuel or imported equipment. It also means doing a better job of determining the optimal pricing of entrance fees, tour packages, and accommodations. Below, we examine several of these factors in more detail.

3.2.3 Getting to the MMA: Tour Operators, Cruise Ships, and Pleasure Boats

Like many MMAs, Abrolhos, Coiba, and the GSSCMR are best visited, and enjoyed, by boat. The marine resources managed by these areas include hard-to-reach coastal areas, offshore reefs and seamounts, and areas with significant spawning aggregations. In all cases, some sort of vessel is required to visit the offshore components of the MMA. In the case of Coiba, a vessel is required just to visit the park (with the exception of very few who fly to the park). There are essentially four types of vessels the visitor can choose: 1) their own pleasure craft, 2) a pleasure craft chartered from outside the country (for instance, many sportfishing charters to Coiba are from Costa Rica), 3) a small, locally operated charter boat, and 4) a large, international cruise ship excursion. The limited number of ways to access these marine parks can make management easier, especially when there are a limited number of local guides or operators that are allowed to take visitors to the park.

Tour Operators

Tour operators can be licensed, and user and concession fees can be collected directly. If guides are local and use local products, then expenditures associated with these guides remain in the local economy. Hargreaves-Allen estimates that 84% of the international visitors to GSSCMR used a local hotel or tour operator. Tour operators servicing the GSSCMR, in turn, earned more than \$600,000 in producer surplus. In Coiba, on the other hand, far fewer international tourists use tour operators. As a result, the high costs of operation and small party sizes (approximately 2-3 tourists/trip) resulted in low producer surplus for many operators (\$55,000). Only 13% of tour package costs in Coiba support local labor. Many of the operators in Coiba were new entrants into the tourism business and it is likely that these profits will increase over time. In Abrolhos, nearly all visitors use one of two local, private tour operators (neither of which would share information on revenues and costs).

Cruise Ships and Pleasure Boats

Many international tourists to Coiba arrive by cruise ship or on sportfishing yachts coming from Costa Rica. Both GSSCMR and Coiba receive a significant number of visitors arriving on their own boats. Aside from park entry fees, cruise ship tourists to

Coiba don't make any local expenditures. Pleasure boaters may buy local provisions and hire local guides, but they also spend much less than those tourists who use local operators. The vast majority (97%) of people visiting the Abrolhos Marine Park did so without buying a package tour for their entire trip, but did pay for a boat tour of the park.

3.2.4 Tourism and Ecological Condition

The link between sportfishing and ecological health is obvious, but complicated. Sportfishers, and spearfishing scuba divers and snorkelers, enjoy the bounty of biological resources of the MMAs. They also can deplete certain species, especially if fishing pressure is highly localized.

Non-extractive users also benefit from healthy ecosystems and the species they support. In Abrolhos, 70% of visitors participated in a whale watching tour. In GCSCMR, 38% of reserve visitors participated in a whale shark watching trip and many had chosen Belize as a destination as a direct result of the whale shark watching opportunities. Because of its size and diversity, Coiba offers biological, cultural, and "sun and sand" attractions for visitors. All of the visitors to Coiba interviewed by Montenegro reported a visit to the park's most famous beach; more than 60% visited the former political prison that lies a short distance from the park headquarters. Still, more than 70% of those Coiba visitors that were interviewed also visited more remote locations known mainly for spectacular dive and snorkeling opportunities – where visitors can see sharks, manta rays, whales, and turtles.

3.2.6 The Consumer Surplus of Tourists

The consumer surplus associated with visiting the MMA represents how much the visitor benefits from visiting the MMA, beyond what it costs to visit. Consumer surplus is one measure of the economic value that the MMA contributes to society. When the consumer surplus is enjoyed by local or national visitors, then this well-being accrues directly to the home country where the MMA is found. When the consumer surplus is enjoyed by foreigners, this is an economic value that ultimately leaves the country when the tourist goes home.

In all cases, the researchers found that visitors to the MMAs were generally willing to pay more to enter the park than they were required to pay, meaning that there are opportunities for increasing management funds. In Belize, visitors to the GSSCMR had a WTP of \$14 beyond what they actually paid for reserve entry; the chance of interacting

with whale sharks increases their WTP by US\$15. In Coiba, the WTP to enter the park for foreigners was \$4 above the actual fee of \$20. When asked if they would pay \$25 to enter the park, 69% of international visitors said “yes.” Seventy-two percent of nature tourists to Coiba would pay this amount. In Brazil, Amend et al. found that Brazilian tourists were willing to pay US\$ 7.50 more than they had to pay to enter the park with those going whale watching willing to pay the most: US\$8.77. It is interesting to note, though, that these higher values for Abrolhos were driven by a few very high responses. The median willingness to pay, a measure that is not affected by these outlying responses, was US\$5.05.

The relatively low consumer surplus values associated with Coiba indicates that much of the consumer surplus enjoyed by visitors may be dissipated by other costs of their journey. To increase the value of the park, and thus the willingness to pay of visitors, the parks must help to lower costs of access or improve the visitor’s experience, through some combination of better services and access to more natural attractions.

3.3 Local Use Values

Local use values were assessed only for the GSSCMR in Belize where many people live near, know, and use the park. The total willingness to pay for all local users, beyond what they had to pay was estimated to be just over \$100,000 annually for access to the park for fishing, tourism and recreation – a value that represents how much this MMA contributes to the economic well-being of the 180 households nearest the reserve.

In the case of Coiba, the MMA is remote from local communities and there are very few opportunities for local recreational or subsistence uses. The local use value of these areas is likely to be low. It is unclear whether there is a substantial use value component for Abrolhos, but there are a number of communities that have easy access to the MMA.

4 Using Economic Information to Improve Management in MMAs

Marine managed areas do not work without some level of investment. The MMA requires planning, labor, monitoring, enforcement, and sometimes the purchase of land and durable equipment, including boats and buildings. Determining the right level of investment requires some understanding of the value of investment. Returning to Figure 1, we can think of the economic value of investment as the difference in economic value of ecosystem-dependent activities with and without marine management. Because some of these values occur in the future, we need to compare the present value stream of

spending required for MMA operation with the present value of the stream of “benefits” (the difference between economic value with and without management).

While it is hard to know in advance how management will affect future values, we can use our baseline of values to learn a thing or two about appropriate levels of spending on management. First, the gross revenues associated with an MMA far exceed the value of the MMA. Equating gross revenues with the value of management is a mistake often made in the literature (see Pendleton [1995] for a critique of one such valuation of the Bonaire Marine Park). Second, the baseline of economic value (producer surplus or profits and consumer surplus) provides a glimpse at the maximum investment value of marine management. In the case of the three MMAs examined here, we focus on only two components of economic value: fisheries and tourism. For Coiba National Park, Montenegro estimates that visitation to the park likely generates in excess of \$150,000 in producer and consumer surplus and could generate an additional net value of \$100,000 if further investment were made in the guesthouse. In the GSSCMR, Hargreaves-Allen estimates the value to be nearly \$800,000 and in Abrolhos, the economic value of tourism is \$50,000.

To understand the economic value that management could contribute to these activities, one must consider how better management would affect economic activity. Could it increase activity and value? Could it prevent a decline? If so by how much? Such simple “what if scenarios” help to provide a rough estimate for the potential value of management.

Of course, there are other values associated with MMAs that we have not considered here: nursery values for fisheries outside of the MMA, carbon sequestration and oxygen production values, coastal protection benefits, biodiversity values, etc. A similar thought exercise needs to be undertaken when considering the potential value of investment.

4.1 Capturing More of the Value of the MMA

Often, the MMA fails to capture all of the value that it provides to visitors and local businesses. Estimates of the producer and consumer surplus associated with MMA use provides an upper bound of how much the MMA might be able to charge for access to the marine area. In Belize, Hargreaves-Allen uses demand curves based on data collected about visitor values to show that if profit maximization was the sole goal, entrance fees should be raised to US\$24 per person per day, whale shark entrance fees to US\$30. These higher fees would be paid by 50% and 55% of visitors respectively, which could have an effect on visitor numbers and spending in the nearby village. Even if maximum profits are taken, by charging profit maximizing fees, only US\$88,903 would be raised, which would only cover the reserve’s fuel costs.

The valuation studies undertaken at each of the MMAs examined here show that different types of users place different values on the use of the MMA. This kind of information can help the MMA better tailor user fees to particular users (in much the way that user fees already are differentiated by use and user for Coiba National Park). It can also be used to understand supportive or illegal behavior of users, to increase awareness of benefits and so to increase stakeholder support and decrease the need for enforcement.

4.2 Adaptive Management

Because the MMAs examined here are relatively new, management within these areas is likely to evolve over time. As yet, we do not understand how different benefits change over time and in response to changes in MPA management, but it is likely that such changes will have some impact on the economic use and value of the MMA. Regular monitoring of ecosystem-dependent activities and careful estimates of the value of these activities will help the manager understand the effects of marine management on these values (and thus the value of marine management). In some respects, maximizing the net benefits of MMAs is a worthwhile common goal which could be pursued. Increasingly, marine management is spatial in nature; areas within the MMA are set aside for different uses or for differing degrees of protection. In these cases, the usefulness of economic data for management will be improved if the data also include spatial information. Where in the MMA are certain uses concentrated? Where do these uses generate highest value? How does the MMA affect visitation, and thus value, to these areas? Which groups of people benefit from different activities or changes in those activities? Which areas are likely to increase benefits most, given specific changes in management?

While biological monitoring often is considered an essential part of ongoing marine management, economic monitoring should be too. When it isn't, marine managers operate with little understanding of how their actions affect the economic value of the resources in their care.

4.3 Limitations of the Synthesis

Many of the costs of creating a new marine reserve or marine managed are incurred in the present, while the benefits of the MMA are enjoyed in the future. The individual studies covered in this synthesis varied in the degree to which they attempted to predict the future value of the MMA in question. In fact, predicting the future benefit of these MMAs is difficult – none of these MMAs yet has a significant history and thus there is little upon which to gauge the future benefit of these management activities. It is common

for analysts to try to put the cost of an MMA in the context of the overall benefits of an MMA. This, of course, is the wrong comparison. As explained earlier in the report, the benefit of the MMA is the degree to which the MMA changes the net value produced by the resources managed. With only limited insight into the future impacts of the MMA, it is difficult to know what the incremental impact of the management will be.

The synthesis also does not consider the multiplier effects of spending that is generated by the MMAs. We know that local spending can help support other jobs at local shops, for vessel and motor repair, transportation, and other elements of these local coastal economies. These multiplier effects, however, were not estimated by the individual study authors, largely because accurate multiplier estimates were not available for these areas.

5 Conclusion

Event remote and relatively unknown MMAs like Abrolhos National Park, Coiba National Park, and Gladden Spit and Silk Cayes Marine Reserve can generate substantial economic value to a wide range of stakeholders. Other MMAs, closer to people, markets, and economically valuable marine areas could generate even more value. All the specific attributes and uses of MMAs will determine their value, so values will vary widely. Valuation studies are critical to justify continued or increased investment and to maximize benefits of budgets and MMAs themselves.

Despite the potential economic value of marine managed areas, economic data still play a mostly *post hoc* role in deciding where to locate MMAs, how to draw their boundaries, how much to invest in MMAs, and how to manage these areas. Economic data on prospective areas for marine management should be collected well in advance of the declaration of an area as an MMA. Doing so would help to ensure that the MMA is sited to protect economically important resources. This could help to reduce the conflict that undermines many MMAs.

Economic data also are required if marine managers are interested in improving human well-being through their management actions. The economic data needed for basic management decisions are not difficult to collect and, with a small amount of training, volunteers and park employees can be trained to collect basic economic information – including, but not limited to, data on park visitation and fisheries landings. Combined with periodic economic valuations by trained economists, regular collection of basic economic data could dramatically improve MMA management.

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