

An Economic and Ecological Analysis of the Bonaire Marine Park

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ABSTRACT

This case study of the Bonaire Marine Park (BMP) in the Caribbean is a combined ecological and economic analysis. It has become increasingly obvious that, rather than selecting the extremes of strict preservation or unmanaged development, balanced use of marine resources for both economic and ecological functions is central to their sustainable management. This study estimates the benefits and costs associated with dive tourism, as well as the willingness-to-pay for park protection. The BMP study explicitly considers the link between the production of ecological and economic benefits, and identifies the limits to increasing use. For details see Scura & van't Hof (1993) and Dixon, Scura & van't Hof (1993, 1994).

1. THE PHYSICAL AND SOCIO-ECONOMIC SETTING OF BONAIRE

Bonaire, a crescent shaped island with an area of 288 square km, is located in the Caribbean Sea approximately 100 km north of the coast of Venezuela (figure 1). The resident population of Bonaire was estimated at 10,800 in 1990. The waters of the Caribbean Sea surrounding Bonaire — from the shoreline to a depth of 60 meters — are officially protected as the Bonaire Marine Park (BMP). The economy of Bonaire is strikingly undiversified: the economic mainstay for Bonaire is tourism, particularly that related to SCUBA diving; almost

17,000 SCUBA divers visited Bonaire in 1991. Supporting activities include hotels, a modest number of restaurants and shops, and a few casinos and night clubs, ground tour operators, rental cars agencies and transport services. Based on tourism statistics, the annual rate of growth of diver visitation to Bonaire is approximately 9 to 10 percent per year.

In the early 1980s the BMP was established with aid from the Dutch Government and other sources. The failure to introduce a visitor fee system in 1981 created serious financial difficulties for the Park. Eventually, with no staff or funding, the Park became a 'paper park' — established on paper but without any actual management presence. Early in 1990, however, after serious concerns about the lack of formal management of the BMP, an increase in diver activity, and the consequences of coastal development in general, the Island Government of Bonaire commissioned an evaluation of the situation, which resulted in the following major recommendations:

- introduce a visitor fee system;
- introduce a licensing system for commercial water sports operators; and
- create a new institutional structure for the BMP, including representation from the tourism industry.

Figure 1. Bonaire, Netherlands Antilles. ►



The Park was re-established and revenues were generated by the introduction of an annual admission fee of US\$ 10 per diver to help pay expenses. In 1992 the fees (called 'admission tickets') raised over US\$ 170,000, enough to cover salaries, operating costs and capital depreciation. The Park also receives income from the sale of souvenirs and books, and from donations.

The study estimated both the impact of tourism on the BMP, and the importance of tourism to the economy of Bonaire. Although it is not possible to value biodiversity per se, one can consider biodiversity and clear water as both a direct and a derived demand from dive tourism, and use information on that demand to examine willingness-to-pay for these ecological services.

2. ECOLOGICAL BENEFITS AND COSTS OF THE BMP

To evaluate the success of the BMP in providing protection to the marine ecosystem, van't Hof conducted a visitors' survey of 79 SCUBA divers to obtain their perceptions of the present condition of the Park and their rating of selected parameters in comparison to other Caribbean areas or to the condition of BMP in the past. These questions helped to assess the environmental carrying capacity of the Bonaire Marine Park from a diver's perspective. Second, a photoanalysis was carried out to analyse coral cover and species diversity.

The majority of the divers interviewed rated the present condition of the reefs as high and the overall condition of the reefs in Bonaire better than or equal to any other destination they have visited, with the exception of Little Cayman and Cayman Brac. The results of the photoanalysis indicated that increased diver use was having an adverse impact on the coral reefs. The comparison of coral, both over time and between sites, indicated that the extent of coral cover has decreased significantly at the most frequently dived sites. The higher species diversity indices at the most frequently dived sites in comparison with the control sites confirm the intermediate disturbance principle: a higher species diversity is maintained at intermediate levels of physical

stress or disturbance as ecological 'niches' are opened up for new species to occupy. As stress increases, however, species diversity declines. The highest diversity in the BMP is found at sites, which are exposed to moderate wave action and swell.

Perhaps the most difficult question to address is: *What is acceptable in terms of diver-induced damage and what isn't?* Based on the interviews with divers, and based on the data on coral cover and species diversity from the photoanalysis, it appears that visitation at certain sites had already exceeded the local carrying capacity.

The results of the photoquadratic analysis suggest that there may be a critical level of visitation above which the impact becomes significant. This relationship is illustrated in figure 2, where the apparent threshold stress level is between 4,000 to 6,000 dives per year per site. (The average visiting diver makes 10 or 11 dives during the course of his or her stay on Bonaire.) Based on the number of available dive sites, it was possible to estimate a conservative 'annual carrying capacity' of 190,000 to 200,000 dives per year. Annual use was already more than 180,000 in 1992, so this level will be

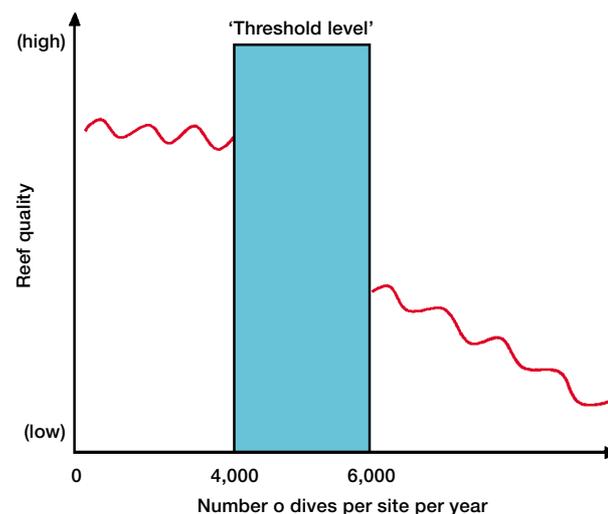


Figure 2. Diving Intensity and Threshold Stress Level
(Source: Dixon, Scura & van't Hof 1993).

associated with dive tourism and the BMP. In 1992, diver (the 'admission tickets') and other user fees, the one source of 'direct' revenues from use of BMP, totalled about US\$ 190,000. This amount is very small in comparison to other park-related gross revenues.

Total *gross revenue generated* through dive-based tourism was estimated at US\$ 23.2 million in 1991. Data on revenues were obtained through interviews with hotels and dive operators. Of the total revenues generated, US\$ 10.4 million is attributable to hotels (including hotel restaurant sales), US\$ 4.8 million to dive operations (including retail sales in dive shops), an estimated US\$ 4.7 million attributable to other expenditures including non-hotel restaurants, souvenirs and car rentals, and US\$ 3.3 million for air transport of diving tourists on the local airline.

Employment should not strictly be considered a benefit. In an economic sense employment is a cost of generating total gross revenue. Nevertheless, employment, particularly of locals, is probably the most long lasting 'benefit' to the local economy of the activities in the BMP, especially since alternative employment opportunities are very limited. Employment in activities associated with the BMP is estimated to be as much as 755 local workers and up to 238 foreign workers.

The financial returns from Park-based recreation contribute to *tax revenues* for the Island Government and generate employment. The Island Government of Bonaire collects several direct and indirect taxes; it is estimated that for 1991 total government revenue from *indirect taxes* (e.g. income, land, and business) was approximately US\$ 8.4 million. Even if the portion of this revenue attributable to dive-based tourism could be easily calculated, these revenues represent transfer payments rather than additional benefits generated by use of the park. Taxes levied by the Island Government directly on tourists include room tax, casino tax and departure tax. Room tax is calculated at US\$ 2.25 per room night. Casino tax and departure tax are calculated on a per visitor basis at US\$ 1.12 and US\$ 9.83, respectively. The total government revenue generated in 1991 through these taxes levied directly on visiting divers is

estimated at US\$ 340,000. Revenues from these taxes may be considered as additional revenue generated for the Island Government through use of the BMP.

Retention of Economic Benefits in Bonaire

There are, however, several factors, which combine to limit the amount of revenues which remain in the local economy. First of all, sales in the tourism sector are dominated by offshore sales of packages commonly referred to as voucher sales. The tourist pays the agent in the United States or Europe for the complete package, including the goods and services to be provided in Bonaire, and in return receives a voucher to be presented to the hotel and/or dive operation representative upon arrival in Bonaire. As a consequence of this only a small portion of gross revenues generated by dive tourism effectively remains in Bonaire. This surplus, however, is a clearer measure of the true economic benefits to Bonaire of the BMP.

Costs of Protection

The costs of the establishment and protection of BMP include direct costs, indirect costs and opportunity costs. Based on data provided by the BMP management, the direct costs associated with the establishment, subsequent rehabilitation and initial operation of the BMP were estimated to be approximately US\$ 518,000; annual recurring costs are approximately US\$ 150,000. (The US\$ 10 user fee generated revenues of over US\$ 170,000 in 1992, its first year, enough to cover operating costs and contingencies.) The opportunity costs of a park or protected area are the benefits that are lost as a result of the establishment and operation of the park. These include the value of forgone output from prohibited uses of resources in the protected area or, the forgone value of conversion of the site to an alternative use. Since BMP is managed as a multiple use area where few uses are strictly prohibited, opportunity costs are minimal.

Willingness-to-pay for BMP

Given the controversy surrounding the institution of a user fee system, a contingent valuation survey was conducted in late 1991 to get an inference of visitors' gener-

al perception of and willingness to pay user fees for the BMP. An overwhelming 92 percent agreed that the user fee system is reasonable and would be willing to pay the proposed rate of US\$10/diver/year.

Approximately 80 percent of those surveyed said that they would be willing to pay at least US\$ 20/diver/year, 48 percent would be willing to pay at least US\$ 30/diver/year, and 16 percent would be willing to pay US\$ 50/diver/year, yielding an average value for WTP of US\$ 27.40 (excluding the 8 percent who were not willing to pay a fee). One could only capture this average value if one were a perfectly discriminating price setter and charged each visiting diver their entire WTP for park use. Of course, one cannot do this, so an admission fee is set that captures part of the WTP.

Clearly the average willingness-to-pay exceeded the relatively modest US\$ 10 fee instituted in 1992 (although this amount would cut off some use as you moved up the demand curve). The difference between what people would be willing to pay for a good or service and what they actually pay is known as consumers' surplus (CS). This value is not observed in market transactions and, in the case of BMP, is not captured by dive operators or hotels. However, it is a very important economic value, as it represents that portion of the value of the diving experience that is above what is paid for it in the market (including transport and ground costs). At

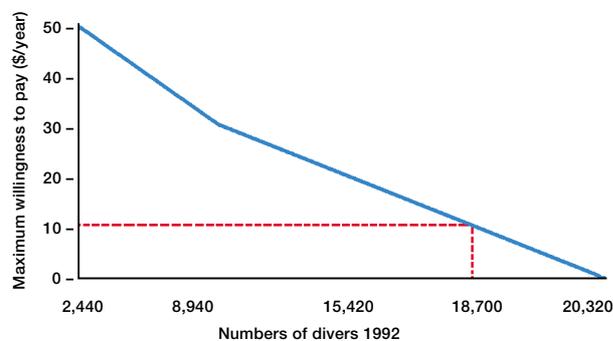


Figure 3. Willingness-to-pay for Park Management, Bonaire Marine Park (Source: Dixon, Scura & van't Hof 1994)

the current rate of dive visitation (an estimated 18,700 divers in 1992) admission fees and estimated CS total US\$ 512,000 per year, of which US\$ 325,000 is CS. Figure 3 presents the information from the WTP survey, and indicates the area of remaining CS.

4. CONCLUSIONS

The ecological studies carried out on the marine ecosystem found measurable degradation around the dive-boat moorings. The data suggest that there may be a critical level of diver use of about 4,500 dives per year at individual sites, after which reef degradation becomes apparent. (In this case information on actual diver use was compared to observed degradation [a physical indicator] to develop an estimate of the threshold stress level.)

The economic analysis illustrates the dependence of Bonaire on dive tourism. Its small size, modest resource endowment, dry climate and relatively remote location combine to limit the potential for other forms of economic development. There is scope for both increasing diver-based revenues (e.g. attract more visiting divers) and increasing retention of diver-related income in Bonaire; the latter will require changes in the type and style of tourism development.

4.1 Assessing the tradeoffs

Are continued expansion of dive tourism (with its associated economic benefits) and ecosystem protection compatible? The data presented from Bonaire indicate that it may rapidly be approaching a point whereby increased dive tourism results in measurable degradation of the marine environment. The physical stress constraint, however, may be changeable. Figure 4 on next page presents a simple schematic relating an apparent stress threshold on the marine ecosystem on the vertical axis to the intensity of diver use on the horizontal axis. Level A represents the level of stress (either from divers or on-shore activities) at which reef degradation becomes noticeable. Below this level there is no, or minimal, impact. Above this level there is a loss of coral cover, reduction in species diversity, decreased visibility and other impacts.

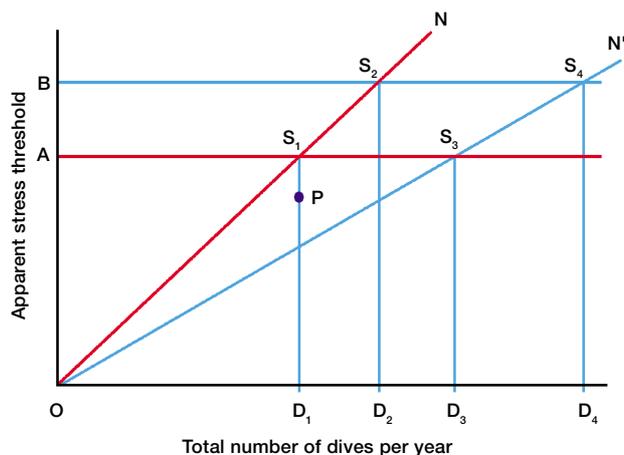


Figure 4. Park Management, Diver Education, and Apparent Stress Threshold (Source: Dixon, Scura & van't Hof 1993). Horiz as: $D_1 = 200,000$, $D_2 = 400,000$.

It may be possible to raise the apparent stress threshold to level B by, improved management — rotating dive sites, spacing out divers, regulation of underwater photography (e.g. ban tripods, promote better buoyancy control), controlling land-based pollution, and monitoring and supervision of park users. (These management measures do not *increase* the tolerance of the marine ecosystem to stress, rather they help to reduce the amount of stress per dive and to distribute the burden more evenly across the ecosystem. Such measures require both money and legal authority.)

The horizontal axis maps the most important direct determinant of reef stress — diver activity. Line ON represents the impact of diver use of the park, measured in the number of single tank dives per year. At point S_1 diver use is such that ecosystem degradation begins to be noticeable. If there is improved park management, this 'stress point' is shifted to point S_2 . However, not all divers are equal and the level of stress per dive varies with the skill of the diver. In general, an experienced diver has better buoyancy control and 'reef etiquette' and imposes less stress on the reef ecosystem than the novice diver. Consequently, diver education can shift

out line ON to ON' by reducing the average stress per dive, thereby expanding permissible use of the park's waters, and leading to increased economic benefits.

The result of these two factors — improved park management and diver education — is to increase the effective carrying capacity of any given site and the park as a whole. Improved diver education can shift the carrying capacity to point S_3 , while improved park management and diver education can shift the point to S_4 . Since more divers mean more revenue, the increase in dives from D_1 to D_4 represents an estimate of the potential economic gain to the economy of Bonaire from these management measures. Based on study results, the increased spending associated with a doubling of the number of dives (and divers) could mean increasing gross revenues in Bonaire by US\$20 million or more per year.

At present Bonaire Marine Park, with some 200,000 dives per year, already receives many experienced divers who have good 'reef etiquette', and actual diver impact thereby falls on a line between ON and ON'. The management of the park, both by the BMP authorities and the dive operators themselves, has also helped to raise the effective damage threshold level and there is only limited, localised reef degradation. The current situation is represented by point P. Nevertheless, Bonaire is approaching the limit where the two uses — protection and dive tourism — are still compatible. It may be possible to expand from the estimated present level of 200,000 dives per year to as much as 300,000 to 400,000 dives or even more. Whether this in fact happens is directly dependent on both improved management and improved diver education.

It is somewhat ironic that the BMP has faced such severe financial restrictions in the past. As the BMP study has shown, dive tourism and the existence of BMP are intimately linked and form the cornerstone of the local economy — without world class diving, Bonaire would receive many fewer visitors. The study illustrated the use of different approaches to estimate both the contribution of dive tourism to a local economy, the role of a marine protected area in providing these ecological

services, diver willingness-to-pay for improved park management, and the identification of ecologically-defined limits on park use.

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