



The Economics
of Ecosystems
and Biodiversity
on Bonaire

Fishery value of coral reefs in Bonaire



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This study is part of the “Economics of Ecosystems and Biodiversity Netherlands” (TEEB NL) study. It is being conducted for the Caribbean Netherlands on behalf of the Dutch Ministry of Economic Affairs.

The Challenge

Fishing provides an important source of income and livelihood on the Caribbean Island of Bonaire, also many people fish for recreational purposes. A large part of the catch is composed of reef-dependent species, which rely on the health and productivity of local coral reefs. To assist decision-makers in understanding and managing these fragile ecosystems contributing to Bonairean well being the economic value of reef-dependent fisheries is determined. Furthermore, the spatial distribution of the economic value of the reef fisheries is revealed to help decision makers understand which areas of reef are most economically important from a fisheries perspectives.

The Approach

By estimating the economic value of the reef fisheries, which consists of both recreational and commercial fishing, the total socio-economic value of reef fishing on Bonaire is estimated. Commercial fishing is valued using the ‘net factor income approach’. The recreational value of the reef fisheries is calculated using both the ‘choice modeling’ and the ‘market valuation’ method. The commercial and recreational values are combined to arrive at a total, annual reef-fisheries value for the Island of Bonaire. This aggregate value is then combined with spatial fisheries production data using ArcGIS to create a fisheries value map of Bonaire.

Results & Recommendations

The reef-related total commercial fisheries are valued at almost \$400,000 annually. The recreational fishery value is estimated at an economic value of almost \$700,000 per annum. These calculations have been used to create an allocation function, which estimates the spatial distribution of the fisheries value along the coral reefs of Bonaire. This in turn can be used to support long-term decision-making for example regarding specific locations for coastal zone development and its impact on commercial and recreational fisheries.



The Challenge

In the current era of financial insecurity and environmental degradation it becomes clear that classical investments in a strong economy are not always contributing to a healthy environment. In reaction, a growing minority is working to demonstrate that the two are interlinked, and that in fact a healthy environment is critical to human as well as financial wellbeing, especially in the longer run. The challenge is to find methods to accurately measure and value these ecosystem services.

This study deals with the socio-economic value of Fisheries as a service of Bonaire's coral reefs. Fishing is an important activity on Bonaire. Although it could be in conflict with other ecosystem services, such as snorkeling and diving, it is also a critical source of income and livelihood for local people. Furthermore, many people fish for recreational purposes. While the export of fish is non-existent, both locals and tourists consume the locally caught fish. The study indicates that 15-20% percent of the local population practice either recreational or subsistence fishing.

A large part of the catch is composed of reef-related species, which we define as species that are reef-dependent for at least one stage in their life cycle. The value of the reef-related catch is related to the health and productivity of local coral reefs.

Recent studies suggest that the health of these coral reefs is declining due to overfishing, nutrient pollution, and climate change (Stokes et al, 2010). Thus, it is crucial to estimate the socio-economic value of the ecosystem service of reef-fishing, in order to assist decision-makers with a better understanding of the economic importance of the coral reefs.

On Bonaire there is great dependence on reef-fish as well as pelagic, migratory fish. Reef-fisheries provide a significant source of livelihood and economic activity on Bonaire. Fishing is done mostly with hand lines or by trawling. Estimating the socio-economic value of the reef fisheries in Bonaire helps demonstrate the importance of the ecosystem services provided by the beautiful coral reefs surrounding the island.

Fishing provides an important source of income and livelihood on the Caribbean Island of Bonaire



Figure 1:
Methodological
framework for the
calculation of the
total fishing value
and creation of a
value map

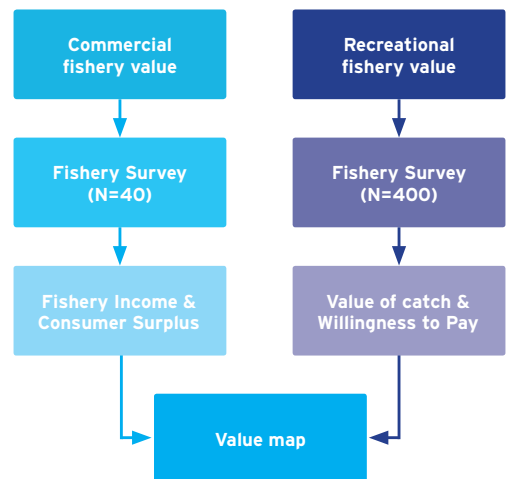
The Approach

'Ecosystem services' is a fairly new term, and are defined as "the benefits that people obtain from ecosystems" (MEA, 2005). The goal of this study is to estimate the monetary value of the ecosystem service Fisheries.

The fishery values, commercial as well as recreational, are estimated by combining data from two studies on the fisheries of Bonaire. Johnson (2011) interviewed 65% of active fishers on Bonaire and Laclé et al. (2012) surveyed 400 households asking questions on recreational fisheries. During these interviews fishermen with subsistence motives are found in both categories. However, the importance of the incentive varies between fishermen. To calculate the value of commercial reef-fishing in Bonaire, the net factor income approach is used, in which the capital costs are subtracted from the revenue of commercial fishing. The recreational value of reef-fishing is calculated based on the Willingness to Pay (WTP) of fishermen to prevent decreases in fish catch. A separate value is calculated for the commercial value of the catch based on the market-price technique.

These two values provide informative comparisons. Once the two methods of recreational value are reconciled, then the final recreation and commercial fisheries value are combined to calculate a total annual reef-fisheries value. This number is then combined with spatial, fisheries production data to create a fisheries value map.

Figure 1



Country Overview.

Bonaire is a Caribbean island of approximately 288 km², with circa 16,000 permanent inhabitants. Bonaire is a 'special municipality' of the Netherlands. The entire coastline of the island is designated as a marine sanctuary in an effort to protect what are considered to be some of the most pristine coral reefs in the Caribbean. Tourism accounts for the majority of economic activity on the island and fishery hold significant economic and cultural influence. Much of Bonaire's economy and many of its residents rely on the quality of the island's ecosystems. Bonaire currently has two protected natural areas: the Bonaire National Marine Park (BNMP) set up in 1979 and the Washington Slagbaai National Park (WSNP) set up in 1969. The national marine protected areas include five Ramsar areas - Lac, Gotomeer, Pekelmeer, Slagbaai and Klein Bonaire.

Results

The analysis generates an economic value of fisheries on Bonaire of approximately \$1 million per annum. The reef-related total commercial fisheries are valued at almost \$400,000 annually. The recreational fishery value is estimated at a market value of almost \$700,000 per annum. By asking the best and worst year of fish catch to commercial fishermen, it is possible to get an idea of the extent to which fish stocks around Bonaire are overexploited. The average worst year reported was 2009, while the average best year was 1998. Figure 2 shows the results categorized by different age categories. The best years are on average longer ago for older fishermen. This data is a strong indication that catches, and implicitly fish stocks, are declining or a long time already, with clear negative ramification on the commercial, recreational, and subsistence values of fishing. The figure also demonstrates a shifting baseline regarding the fact that the best perceived years by the younger generation are close to the worst perceived years by the older generation.

Using expert interviews with fishermen to determine areas where fish are caught, reef productivity, in terms of providing habitat function for fish, is determined. Mora and Sale, (2002) assume that reef-fish populations are more closed than was previously expected, which could mean that fish are depended mostly on that particular reef area where the fish has been caught.

Figure 2

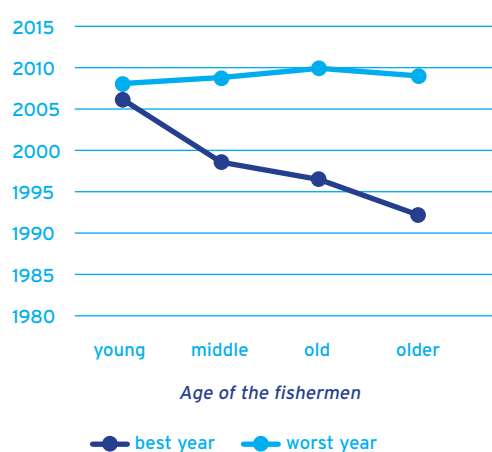


Figure 2:
Best and worst
years of catch
by age category



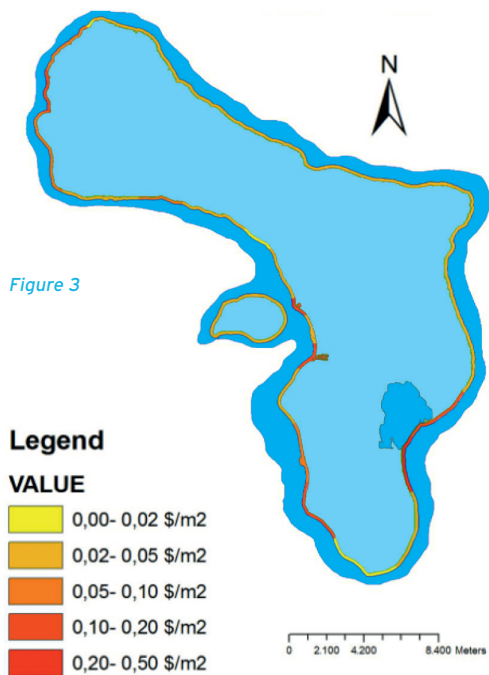


Figure 3

Legend

VALUE

	0,00-0,02 \$/m2
	0,02-0,05 \$/m2
	0,05-0,10 \$/m2
	0,10-0,20 \$/m2
	0,20-0,50 \$/m2

Once the production of each area is determined, an allocation function has been constructed to give each area of the reef a value per meter squared for both recreational and commercial fishing. This function is used to create two separate value maps for each type of fishing (commercial and recreational) using ArcGIS. The reef values in these maps are then aggregated to create the final value fishing map, shown in Figure 3. This map indicates the most economically productive areas of the reef, given fish yields reported by fishermen.

The study suggests that there are certain areas of the reef (the areas in red in Figure 3) that are the most economically significant to reef-fisheries. These hotspots are mainly created by the concentration of recreational fishing; the commercial fishermen fish around the entire island. The value map identifies these key areas, and roughly estimates their spatial value with regards to reef fisheries (approximately 20 to 50 cents per meter squared). The purpose is to elucidate economic values, which must then be used by policy makers to shape the future of the Bonaire coral reefs.

Recommendations

Some interesting findings are presented with regards to the different methods used to estimate the economic value of the reef-fisheries. As the WTP was much lower than the market value of the catch for recreational fishing, the importance of fishing as an open access food source seems to be significant, as does the benefit of fishing to Bonaireans not practicing recreational fishing. In local interviews it became clear that fishing was used as a way to reduce food expenses. It also demonstrates a healthy protein intake, which contributes to human wellbeing on Bonaire. In order to sustainably manage reef resources, it is critical to quantify pressures and manage the socio-economic drivers behind them. While the calculations in this analysis could be improved with additional data at a finer resolution, it provides a useful estimate of the magnitude, market value, and spatial distribution of Bonairean fisheries that can be used to inform management decisions.

Further Information

For further information about valuing Ecosystem Services on the island of Bonaire, contact Esther Wolfs (esther@wkics.com) or Pieter van Beukering at IVM (pieter.van.beukering@vu.nl) and the webpage www.ivm.vu.nl/en/projects/Projects/economics/Bonaire

Figure 3:
Spatial allocation
of coral reef fishery
values

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Fishing is used as a way to reduce food expenses

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