

THE ECONOMIC VALUE OF IMPROVING THE ENVIRONMENTAL QUALITY OF GALVESTON BAY

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EXECUTIVE SUMMARY

Introduction

The objective of this report is to develop the best possible estimates of the economic value of improving the environmental quality of Galveston Bay given the time and resources available. People often ask about the economic value of a natural resource such as Galveston Bay. Some want to know the economic value of the bay in order to rigorously compare the economic benefits of cleaning up or protecting the bay with the costs of improving its environmental quality. Others want to have an estimate of the dollar value of the natural resource in an attempt to answer the question, "Is Galveston Bay worth a lot or a little?" Whatever the uses to which estimates of economic value are put, such estimates are a common ingredient in public policy debates about appropriate strategies for managing natural resources.

The fact that estimates of economic value are commonplace in public policy discourse does not make them easy to construct in a conceptually sound, meaningful manner. Indeed, assigning an economic value to an ecosystem as complex and productive as the Galveston Bay estuary may seem to many people to be at best a fool's errand, and at worst a moral outrage. Yet because any plan for cleaning up, protecting, and managing Galveston Bay will inevitably cost millions of dollars, the Galveston Bay National Estuary Program (GBNEP) felt that people in the Greater Houston-Galveston Area--and elsewhere in Texas--deserved to have the best information available about the economic benefits they could expect to obtain from implementing a management plan for the bay.

In order to provide public officials and the general public with an estimate of the economic value of the improvements planned for the Galveston Bay estuary system, GBNEP contracted with the University of North Carolina at Chapel Hill to carry out a "nontraditional" economic valuation study. In this context, "nontraditional" meant that we were not to restrict our focus just to the goods and services provided by Galveston Bay for which market prices are available. Instead, the objective of our research effort was to look broadly at how changes in the environmental quality of the bay would affect its economic value.

The Concept of Economic Value

Yet what exactly would nontraditional estimates of economic value measure? What kind of information would public officials, policy analysts, and the general public like to have about the economic value of implementing a management plan? Clearly they want to know how the implementation of a management plan would affect the bay's water quality and broader ecosystem components. But policy makers and the general public also want to know how much people care about--or value--such changes in the bay. This question takes us into the realm of economic valuation.

It is important to carefully define what economists mean by "economic value" because their definition is much broader and more encompassing than many people realize. The economic value of a natural resource is not simply the amount of income that individuals can receive by using it (i.e., from harvesting fish); instead, economists attempt to measure how much people's well-being would decrease if a natural resource were lost, or how much people's well-being would increase if a natural resource were better managed or its quality improved. In other words, when economists try to estimate the economic value of Galveston Bay, they attempt to answer the daunting question, "How much better off would people be if a management plan for Galveston Bay were implemented and, consequently, the environmental quality improved?"

How can economists measure a change in people's well-being? They simplify the task and try to answer a related question: "What is the most people would be willing to pay for a specified improvement in the quality of Galveston Bay?" (or, "If the environmental quality deteriorated, how much money would a person be willing to accept in compensation in order to make him or her just as 'well off' as if it had not deteriorated?"). The answers to such questions are measured in dollars and may approximate a change in a person's well-being associated with a change in the environmental quality of Galveston Bay. Economists call these monetary measures of a change in an individual's well-being the total economic value to the individual of the change in environmental quality.

The Research Approach

In this report we attempt to assign a monetary value both to changes in the goods and services provided by the bay, even those not traded in markets, and to changes in the ecological functions of the bay by estimating how much people would be willing to pay for them. This task was similar in many respects to the work of economists trying to estimate the magnitude of the economic damages associated with the *Exxon-Valdez* oil spill in Prince William Sound, Alaska. In the case of the *Exxon-Valdez* oil spill, however, economists attempted to determine how much people would be willing to pay to avoid the environmental damages associated with a similar spill in the future. For us the problem was to determine how much people would pay, not just to avoid a deterioration in the environmental quality of the Galveston Bay estuary system, but also to improve its environmental quality and ecological health .

Although the pursuit of this research objective inevitably resulted in estimates of economic value that are imprecise and open to interpretation, the GBNEP staff felt that it was important for public deliberations to have a sense of the relative magnitude of the economic value of improving the environmental quality of Galveston Bay based on this broader, more comprehensive notion of economic value. Specifically, the GBNEP requested us to move beyond the quantification of the *use values* of Galveston Bay, such as are often assigned to fishing and recreational days, and to look systematically at the *nonuse* values of the bay. Of particular concern to the GBNEP were intangible and aesthetic values, and the contribution of Galveston Bay to "the quality of life and to human life support in a biological and ecological sense."

The principal approach we used in this report to measure the economic value of improving the environmental quality of Galveston Bay is termed the *contingent valuation method* (CVM). This is a survey technique that attempts to elicit information about individuals' (or households') preferences for a good or service. Respondents in the survey are asked a question or a series of questions about how much they value a good or service. The technique is termed "contingent" because the good or service is not, in fact, necessarily going to be provided by the enumerator or research analyst: the situation the respondent is asked to value is hypothetical. The CVM can be used to obtain values of private goods, goods with both private and public characteristics (such as various kinds of infrastructure), and "pure" public goods (such as improvements in water quality). Often it is used to assess preferences for goods or services for which a conventional market does not exist.

The University of North Carolina research team carried out a large contingent valuation survey of randomly selected households in the five counties in the Greater Houston-Galveston Area (Harris, Galveston, Liberty, Chambers, and Brazoria). We decided to split the data collection effort into two parts: (1) a mail survey followed up by an in-person interview and then by a second, short written questionnaire, and (2) a mail-only survey. We referred to the former as the "mail/in-person follow-up" survey and to the latter as the "mail-only" survey.

The data collection effort for the mail/in-person follow-up survey consisted of three main steps. First, a survey packet was sent to each person in a sample of 750 households. In the cover letter, respondents were asked to read the enclosed information. This packet contained a letter of introduction, a questionnaire booklet, and for one half of the respondents, a 13-minute videotape. The information in the questionnaire described the current condition of Galveston Bay and outlined a management plan for protecting and improving its environmental quality. The proposed management plan included such actions as (1) tightening water quality standards, (2) increasing monitoring and enforcement activities, (3) creating new "wetland reserves," (4) establishing a program to test all types of seafood for possible contamination, and (5) establishing a "rapid response" capability to minimize the effects of oil and chemical spills. Participants were then asked to complete the written questionnaire and to return it to one of our three interview locations at any of a specified set of times.

The second step of the data collection effort was to conduct in-person interviews with respondents. The three interview locations were all safe, familiar places near their homes. After arriving at the interview location, they would participate in an in-person interview. In this 30-40 minute interview we asked respondents how they would vote if there were a referendum on whether or not to implement this management plan if it would require adding a specified dollar amount as a surcharge to their monthly water (or other utility) bill. Different randomly selected respondents were given different monthly amounts, and their answers to these questions were used to develop estimates of respondent households' willingness to pay for the management plan (i.e., its "economic value").

The third step was a brief written questionnaire that respondents were asked to complete after they finished the in-person interview. It included questions regarding recreational travel expenditures, attitudes, and socioeconomic characteristics.

The mail-only survey questionnaire was sent to a thousand randomly selected households in the Greater Houston-Galveston Area. It was designed to be comparable to the mail/in-person follow-up survey in terms of the questions asked. However, the questionnaire itself had to be considerably shorter. The questions that were included in the mail-only survey were the same as in the mail/in-person follow-up survey.

Although most of the effort of the University of North Carolina research team was spent on the design and execution of the contingent valuation survey, and on the analysis of the data collected, several additional approaches were also used to measure the economic value of Galveston Bay. These approaches include benefit transfer, net revenue analysis, marginal productivity analysis, and embodied energy analysis.

Results

In total, 234 interviews were successfully completed in the mail/in-person follow-up survey, and 393 interviews were successfully completed in the mail-only survey. After eliminating households that we judged never to have received the survey materials, our response rates in the two surveys were 41 percent and 49 percent, respectively.

Our analysis of respondents' answers to the contingent valuation questions shows clearly that people's answers were not random, but rather could be systematically related to respondents' socioeconomic characteristics and use of the bay in the way one would expect. In other words, we found that high-income respondents were more likely to vote for the management plan at a given price than low-income respondents; that users of the bay were more likely to support the plan than nonusers; and that people in general were less likely to vote for the management plan as the price (i.e., monthly surcharge) for the plan increased.

These results suggest that respondents paid attention to the questions being asked and increase our confidence in the quality of the information obtained. As with any public opinion poll,

however, there is the possibility that respondents misrepresented their answers, in order to influence the results of the study, or misinterpreted the questions that were asked. Our judgment, based on over two hundred in-person interviews, is that the vast majority of these respondents thought carefully about their answers to the valuation questions and, to the best of their ability, gave honest answers.

The most worrisome finding regarding the accuracy and reliability of the contingent valuation results is the significant difference in household willingness to pay between the mail/in-person follow-up survey and the mail-only survey. Our analysis suggests that a typical household that received the mail/in-person follow-up survey was willing to pay approximately 60 percent more than if it had received the mail-only survey (\$21 per month versus \$13 per month). This difference in the results of the mail/in-person follow-up and mail-only surveys introduces uncertainty into our estimates of economic value because we do not know which set of results is the most accurate. We take a conservative approach and use the estimates from the mail-only survey in our estimates of the total economic value of improving the environmental quality of Galveston Bay.

Based on the results of the mail-only contingent valuation survey, after making adjustments to our results to account for differences between the socioeconomic profiles of our respondents and the population of the study area, we estimate that the average household in the Greater Houston-Galveston Area is willing to pay approximately \$7 per month for five years for the management plan described in the questionnaire, or about \$80 per year.¹

The reasons respondents were willing to pay for a management plan for Galveston Bay were revealing. The typical user of the bay was willing to pay substantially more than the average nonuser (about \$7 per month more). However, a typical nonuser was still willing to pay about \$5 per month for the implementation of the management plan. This is largely because of a desire to pass on a healthy environment to future generations. Over 90 percent of the respondents felt that reducing water pollution in the bay was important, and of these people, almost 60 percent said that the most important reason for reducing water pollution was so that future generations could use and enjoy the bay. In the mail/in-person follow-up survey, respondents that voted for the management plan were asked whether they would still be willing to pay for the management plan if they moved away from the Greater Houston-Galveston Area (perhaps due to a job transfer). More than a third said that they would still be willing to pay something even if they moved away.

One interesting way of considering the results of the contingent valuation survey is to view them as a public opinion poll and to ask whether a referendum on a management plan for improving the environmental quality of Galveston Bay would actually pass. In our judgment, the results suggest that a slight majority of the population of the Greater Houston-Galveston Area would

¹ This assumes that nonrespondents are willing to pay one half the amount that respondents are willing to pay. A detailed description of the calculations and weighting procedure used to arrive at these figures is provided in Chapters 5 and 6 of the Main Report.

vote for a plan that increased their water bills by \$5 per month for five years. If such a referendum did pass, a \$5 surcharge on households' water bills would raise about \$60 million per year for the management plan's initiatives. We believe there would be broad public support across all groups in the population for a surcharge in the range of \$1-2 per month (surcharges at this level would raise \$10-25 million per year).

In addition to supplying the data for our calculations of the economic value of implementing the management plan, the contingent valuation survey provided an extensive set of information on the recreational use of Galveston Bay by residents of the Greater Houston-Galveston Area and about people's attitudes and perceptions of the bay. These data show that approximately 19 percent of our mail-only sample respondents used the bay as a site for recreational fishing, boating, picnicking, bird-watching, or hiking more than ten times per year. About 44 percent of the sample used the bay for some recreational purpose at least once a year. Approximately 26 percent of the population of the five-county area used the bay for recreational boating and fishing at least once a year.

However, for the majority of people in the Greater Houston-Galveston Area, Galveston Bay is simply not perceived as a site for recreational activities. Most of our respondents had a negative perception of the quality of Galveston Bay. Only about 18 percent felt that the quality of Galveston Bay had improved over the last five years. More than a third thought it was getting worse. Almost 20 percent said they did not know. Even so, we estimate that Galveston Bay is used by residents of the Greater Houston-Galveston Area for recreational purposes over 7 million times per year (i.e., 7 million "user-days"). This number would certainly increase if the environmental quality of the bay improved.

Most people in our sample do eat seafood from the bay a few times a year and in this sense have a direct interest in cleaning up the bay. However only about 10 percent reported eating seafood from the bay as often as three times a month.

Based on the results of the contingent valuation survey, we estimate that the annual economic value to residents of the Greater Houston-Galveston area of cleaning up the bay is in the range of \$100-150 million. This is a conservative estimate based on the results of the mail-only survey. It is important to emphasize that this estimate refers to the economic value of the bay to residents of the Greater Houston-Galveston area and not to people living elsewhere in Texas or other states. In fact, many people from outside the five-county area use the bay for recreational purposes, and even people living elsewhere in Texas and the U.S. who do not use the bay for recreational purposes may still be willing to pay to improve its quality. In this sense, this estimated range is a lower bound on the total annual economic value of an improvement to the bay.

Estimates of the economic value of the bay that residents already obtain from the current level of recreational fishing and boating and from commercial fishing were also estimated, using net revenue analysis and benefit transfer methods. The calculations of the value of the bay for recreational purposes use two types of data: (1) estimates from the contingent valuation survey

of the number of days people in the Greater Houston-Galveston area use the bay for these purposes, and (2) previously developed estimates of the economic value of a day spent boating or fishing from other locations in the United States. The total annual economic value of the existing level of recreational fishing to users of the bay living in the Greater Houston-Galveston area is estimated to be in the range of \$75-150 million. The total annual value of the existing level of boating to users of the bay who live in the Greater Houston-Galveston area is estimated to be in the range of \$25-50 million. The annual economic value of other recreational uses of the bay to people living in the Greater Houston-Galveston area is estimated to be in the range of \$15-50 million. Rounding these estimates for specific recreational uses, the total annual economic value of Galveston Bay for recreational uses is thus in the general range of \$100-250 million.

The economic value of the bay for commercial fishing is estimated to be on the order of \$1-2 million. This is very low compared to the economic value of recreational uses. This estimate of the economic value of commercial fishing is not the total market value of fish harvested in the bay, but is rather the estimated profit of commercial fisherman, after subtracting their costs from their revenues.² It is important to note, however, that this is an underestimate of what commercial fisherman stand to lose if the water quality of Galveston Bay deteriorated to such an extent that no fish could be harvested in the bay. This is because such a decrease in the water quality in Galveston Bay would also damage fish nurseries and thus the productivity of the food chain that supports fish currently caught in the Gulf of Mexico.

Our estimates of the economic values associated with changes in environmental conditions in Galveston Bay are summarized in Table E.1. One might be tempted to sum these estimates to derive a total economic value of a change from a completely degraded state of the bay to an improved state of the bay (one that would be better than the current environmental condition). Such a summation would, however, be incorrect because it would result in some double counting.

² This estimate does not include benefits to secondary industries that rely on commercial fish catch for their profits. Such indirect benefits are, however, likely to be small.

Table E.1 Estimates of the Annual Economic Value of Changes in the Environmental Quality of Galveston Bay (1993 Dollars)

Change in Environmental Quality	Valuation Method Used		Net Revenue Analysis
	Contingent Valuation	Benefit Transfer	
1. Due to Implementation of the Management Plan: (Use and nonuse values)	\$100-150 million/yr.		
2. Losses Incurred if the Existing Environmental Quality Deteriorated Greatly: (Use values)			
Recreational			
Fishing		\$75-150 million/yr.	
Boating		\$25-50 million/yr.	
Other (hiking, picnicking, camping, hunting, swimming, bird-watching, etc.)		\$15-50 million/yr.	
Commercial fishing			\$1-2 million/yr.

Galveston Bay provides several other services that we did not attempt to value in this research effort. These include waste assimilation and erosion control. The assimilative capacity of the bay is used to dilute and dissipate industrial and municipal wastewater and excess heat (through process cooling).³ The bay is also valuable to many business because it provides an essential transportation artery for the regional economy. However, because the economic value of the bay for transportation uses would not be adversely affected by any of the actions under consideration in the Galveston Bay management plan, we considered it beyond the scope of our research to estimate the economic value of the bay for transportation purposes.

³ Waste assimilation is clearly one of the current uses of the bay. It is important to note, however, that increasing the use of the bay for waste assimilation would decrease the value of the bay for other uses (most notably recreational uses). Correspondingly, improvements in water quality would require decreased use of the bay for waste assimilation, and thus lower the economic value of the bay for assimilative uses.

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