America's Wetland?
A National Survey of Willingness to Pay
for Restoration of Louisiana's Coastal Wetlands

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Abstract

A nationwide survey was conducted to estimate welfare associated with a proposed large-scale wetland restoration project in coastal Louisiana. Both binary- and multinomial-choice survey instruments were administered via Knowledge Networks, with the latter used to estimate willingness to pay for increments in three ecosystem services: wildlife habitat provision, storm surge protection, and fisheries productivity. Results indicate that confidence in government agencies, political leanings, and "green" lifestyle choices were significant explanatory factors. All three ecosystem services significantly affected project support, with increased fisheries productivity having the largest marginal effect, followed by improved storm surge protection, and increased wildlife habitat. Willingness to pay (WTP), in the form of a one-time tax, is estimated to be in the neighborhood of $1,000 per household, with resource users being willing to pay substantially more. A conservative lower-bound estimate of aggregate WTP is $86 trillion, well above a recent $100 billion estimate of restoration cost.

Keywords: choice experiment, consequentiality, contingent valuation, Knowledge Networks, Louisiana, non-market valuation, non-use value, use value, wetlands

JEL Codes: Q51, Q57

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Introduction

The wetlands of coastal Louisiana (U.S.A.) account for 37 percent of the total estuarine herbaceous marshes in the continental United States, support the largest commercial fishery in the lower 48 states, and comprise the seventh-largest delta on Earth (Couvillion et al. 2011). Louisiana's wetlands also play an important role in the nation's energy infrastructure: they contain nearly 9,300 miles of oil and gas pipelines (United States Army Corps of Engineers 2004), the pricing point for natural gas throughout North America (Henry Hub), and Port Fourchon, a port and supply point for hundreds of offshore drilling operations in the Gulf of Mexico. A third of the nation's oil and gas supply and fifty percent of the nation's oil refining capacity is produced or transported in or near Louisiana's coastal wetlands (Louisiana Department of Natural Resources 2006).

At the same time, Louisiana has been one of the states most affected by wetland loss.[1] Coastal Louisiana has undergone a net change in land area of approximately 1,883 square miles from 1932 to 2010, accounting for about 90 percent of the total wetland loss in the lower 48

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[1] Losses are partly due to natural phenomena, such as sea level rise, subsidence, erosion, saltwater intrusion, and tropical storm impacts, but also due to human activities such as dredging for canals, construction of levees and upstream dams, other development, and soil conservation practices which have modified the movement of freshwater and suspended sediment (Barras et al., 2003; (Caffey, Savoie, and Shirley 2003; Dunbar, Britsch, and Kemp 1992; Coastal Protection and Restoration Authority of Louisiana 2007).

states (Couvillion et al. 2011). In 2005, Hurricanes Katrina and Rita destroyed another 200 square miles of wetlands in a single hurricane season (Coastal Protection and Restoration Authority of Louisiana (CPRA) 2007), and these wetlands were further threatened in 2010 as a result of the *Deepwater Horizon* oil spill. Overall, during the past 100 years, these losses represent an acceleration of 10 times the natural rate[2] (Coastal Protection and Restoration Authority of Louisiana 2012b). Future losses are forecasted to be between 700 and 1,756 square miles by the year 2060 (United States Army Corps of Engineers 2004; Desmond 2005; Coastal Protection and Restoration Authority of Louisiana 2012a).

Consequently, and in an effort to garner support for restoration efforts in the state, some have begun referring to Louisiana as "America's Wetland" (America's Wetland Foundation 2012). Although a few studies have estimated the value of wetlands to the public (Bergstrom et al. 1990; Farber 1996; Costanza et al. 2008) they focused only on their value to resource users. Petrolia and Kim (2011) and Petrolia, Moore, and Kim (2011) examined a variety of wetland benefits and sampled the entire state of Louisiana, including both resource users and non-users. These studies provide evidence that support for wetland restoration does in fact exist, but the evidence stops at the state lines. Thus, hard evidence for the existence and magnitude that Louisiana's wetlands truly are "America's" is lacking. We use a nationwide survey to examine the question of whether average Americans truly value the wetlands of Louisiana.

[2] Estimated loss rates vary, with Coreil and Barrett-O'Leary (2004) reporting about 2.3 square miles per year since the 1930s, but in excess of 40 square miles per year during the last 50 years, and between 25 and 35 square miles per year during the 1990s. The most recent estimate is a loss rate of 16.57 square miles per year for the period 1985-2010 (Couvillion et al. 2011).

Specifically, we answer the following two questions: 1) *Are U.S. households willing to pay to restore Louisiana's coastal wetlands, and if so, how much?* And 2) *What specific ecosystem services provided by Louisiana's coastal wetlands are the key drivers of U.S. households' willingness to pay, and what are the WTP increments of these particular services?* We find that support for wetland restoration in coastal Louisiana is widespread across the nation and that the highest valued ecosystem service is fisheries support, followed by storm surge protection and wildlife habitat.

There are many estimates of the value of benefits provided by wetlands in the extant literature. [3] Several studies account for both resource users and non-users, but samples were drawn either locally or regionally. McVittie and Moran (2010) is the only study to our knowledge that draws a nationwide sample, and that for the United Kingdom. The study that comes closest to one of national scope in the U.S. is Wallmo and Edwards (2008), who sample respondents in fourteen Atlantic coast states (and Washington, D.C.) to estimate WTP for Marine Protected Areas in the Northeast U.S. However, the proposed project sites for both McVittie and Moran and Wallmo and Edwards span the geography of the sample, i.e., respondents are not necessarily geographically removed from the projects being proposed. The present study is then, to our knowledge, the only U.S. wetland valuation study whose sample is drawn nationally, and

[3] See Bauer, Cyr, and Swallow (2004); Bergstrom et al. (1990); Brander, Florax, and Vermaat (2006); Brouwer et al. (1999); Carlsson, Frykblom, and Liljenstolpe (2003); Christie et al. (2006); Johnston et al. (2011); Kazmierczak (2001a, 2001b, 2001c); McVittie and Moran (2010); Milon and Scrogin (2006); Petrolia and Kim (2009); Petrolia, Moore, and Kim (2011); and Woodward and Wui (2001).

comprised largely of respondents that are both non-users and geographically very far removed from the study site.[4]

Furthermore, although several studies provide welfare estimates for specific ecosystem services provided by wetlands, this is the only study of Louisiana's wetlands that utilitizes the multinomial choice-experiment method to obtain such estimates. We implement a split-sample design to administer both a binary-choice and multionomial-choice version of the valuation survey. We focus on three wetland attributes: storm surge protection, wildlife habitat, and fisheries productivity.

Survey Design and Administration

The survey instrument was designed to estimate welfare for changes in ecosystem services associated with coastal wetland and barrier island restoration in Louisiana's Barataria and Terrebonne estuaries (BTNE), located just south and west of New Orleans (see Figure 1). The survey proposed to respondents one or more wetland and barrier island restoration programs and asked respondents if they would hypothetically be willing to pay a specified amount to implement one of the proposed restoration programs. The survey explained to respondents that wetlands and barrier islands in the estuary were being lost due to "natural erosion, sea-level rise, sinking of land, winds, tides, currents, and major storms", as well as human development such as the construction of river channels and levees. Respondents were asked to consider, evaluate, and

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[4] Here we are excluding the seminal study of the Exxon Valdez oil spill (Carson et al. 2003), which, although not a "wetland" study, fits loosely into this category, which focused exclusively on non-use value, and whose sample (the continental U.S.) was obviously very far removed from Prince William Sound, AK.

indicate their preference for a set of proposed projects that would restore roughly 50% of land lost since 1956. The year 1956 was chosen because this was the year when diligent measurement of land loss began.

The projects under consideration were large-scale land restoration projects which included "wetland building, barrier island restoration, freshwater and sediment diversions, and the movement of large amounts of soil on barges and via pipelines." The survey focused on three main benefits of restoration: improved wildlife habitat, measured as the percentage of created land generally suitable for wildlife habitat; storm surge protection, measured as the percentage of residents in the area that would have improved storm surge protection; and improved commercial fish harvest, measured as the percentage improvement in harvest levels of major commercial (Gulf of Mexico) fish such as oysters and shrimp. The specific levels of changes to these ecosystem services depended on the version of the survey each respondent received, as detailed in the next paragraphs.

Two versions of the survey were constructed. In the first version, respondents were presented with a single restoration program and were asked whether they were willing to pay a stated amount to implement the program, or to not implement any project, incur no cost, and allow land loss to continue at its current rate. This version is referred to as the binary-choice version since respondents are choosing between two alternatives, "yes" and "no". The project in the binary-choice version proposed to restore 50% of land lost since 1956, 50% of which would be suitable for wildlife habitat, which would increase storm surge protection for 30% of residents in the estuary, and increase fish harvest levels by 15%. (Note that these levels correspond to the "intermediate" levels used in the multinomial-choice version discussed below. See table 1.) The price to the respondent for the project took on one of nine randomly-assigned dollar values {$25, 90, 155, 285, 545, 925, 1305, 2065, 2825}. Figure 2 shows an example choice question for the binary-choice version. In the second version, respondents were asked to choose between two different restoration programs, each available at a specified price, which differ according to attribute levels (see Table 1 for the levels used). Alternatively, people could vote to implement neither of these programs, incur no cost, and allow land loss to continue at its current rate. This version is referred to as the multinomial-choice version because respondents are choosing between three alternatives (either of the two programs or neither).[5] Figure 3 shows an example choice question for the multinomial-choice version. Note that all respondents under both versions were also given the option to not vote, i.e., to opt out of responding to the vote question entirely.

Knowledge Networks was contracted to administer the survey. The target population consisted of non-institutionalized adults age 18 and over, residing in the United States. Knowledge Networks sampled households from its KnowledgePanel, a probability-based web panel designed to be representative of the United States. Prior to administering the survey instrument, the authors met with staff at the Barataria-Terrebonne National Estuary Program

[5] In these types of surveys, the set of options from which the respondent chooses is referred to as the "choice set". Although most multinomial-choice surveys utilize "repeated choice", wherein each individual respondent evaluates multiple choice sets, we wished to avoid any of the confounding effects associated with this approach (see Bateman et al. 2001, 2004; Day et al. 2012; Day and Prades 2010; DeShazo 2002; Holmes and Boyle 2005; Krosnick 1999; Ladenburg and Olsen 2008; and McNair, Bennett, and Hensher 2011) and presented each respondent with exactly one choice set to evaluate. This also facilitates comparison with the results of the binary-choice version.

center in Thibodaux, Louisiana, to discuss the feasibility and believability of projects like the one proposed in the survey, the relevant project attributes that people would most likely care about, etc. In early 2011, two focus groups were held, using staff from various departments at Mississippi State University, the first of which was used only to narrow down the appropriate attributes for the survey, and the second of which focused on a more complete version of the survey to check for clarity, bias, etc. These participants were deliberately chosen not to be experts in anything related to the study because our target population was the general U.S. population. The survey instrument was then pre-tested on 30 Knowledge Networks panelists, and a second pilot version was administered to roughly 100 panelists. Each was used to hone the bid values at which the proposed restoration projects were available. The main survey was administered by Knowledge Networks between April 21 and July 23, 2011. Out of 5,185 people sampled, 3,464 (66.8%) responded. Of the 3,464 respondents, 1,397 and 2,067 completed the binary- and multinomial-choice version, respectively.

Data and Empirical Methods

Overview of the Data

Table 2 reports a comparison of U.S. population demographics with the sample. Also reported are the figures for the regression sub-samples (discussed below). The sample demographics match those of the population closely. With the exception of slight over-representation of white, educated, and internet-accessed respondents, the sample was representative of the overall population.

Table 3 reports the proportion of responses to three general survey questions regarding respondent familiarity with the study area and overall concern for the problem. Roughly twothirds of the sample was not at all familiar with the wetland loss issue in Louisiana, and about one-third at least somewhat familiar. About three-fourths had never heard of the specific study area, whereas about one-fourth had either visited it, lived there, or currently lives there. Thus, it initially appears that if Louisiana's wetlands are indeed "America's wetlands", it is not because people are familiar with them. However, over eighty percent of respondents indicated that they were at least mildly concerned about wetland losses in Louisiana, with seventeen percent not at all concerned.

Econometric Modeling

We assume that respondents choose the alternative (implementation of a project or the status quo) that they believe will maximize their utility, a model known as the random utility model. Let the utility for individual *i* from alternative *j* be described as

$$U_{ij} = \alpha_j + \boldsymbol{\beta}'\boldsymbol{x}_{ij} + \boldsymbol{\delta}_j'\boldsymbol{z}_i + \varepsilon_{ijk}$$

where α_j is an alternative-specific constant, $\boldsymbol{\beta}$ is a vector of coefficients on alternative-specific attribute levels $\boldsymbol{x}_{ij}$ (including bid), $\boldsymbol{\delta}_j$ is a vector of coefficients on individual-specific characteristics $\boldsymbol{z}_i$ for option *j*, and ε_{ij} is an error term, which captures the components of utility that are known to the respondent but unknown to the researcher. For the binary-choice model, the vector $\boldsymbol{\beta}$ in Equation 1 contains bid only, and thus reduces to the scalar β .

The parameters of the binary-choice model are estimated using a logit model (see Haab and McConnell 2002). Because the attribute levels of the program were the same across all individuals in the BC treatment, the coefficients on the choice-specific attributes are inestimable. The multinomial-choice model is estimated using a multinomial logit model (see Greene 2012). Utility associated with the status-quo choice is set to zero in the multinomial-choice estimation.

Given the parameter estimates, we can estimate the average respondent willingness to pay for various scale wetland restoration projects as well as the average willingness to pay for incremental changes in the project attributes (see Haab and McConnell 2002).

Consequentiality

The usefulness of responses to surveys on hypothetical referenda, in particular, standard contingent valuation (CV) surveys, continues to be debated.[6] Carson and Groves (2007, 2011) argue that as long as the survey question is *consequential* we can predict how agents should respond, given their incentive structure. Their work has largely shifted the debate on stated-preference methods from the question of whether responses to hypothetical questions differ from what they would be if the questions were "real" to the issue of whether responses to hypothetical questions are consequential. A survey question is consequential if the agent believes his response will affect some outcome that he cares about. From such questions we can make predictions about how agents should respond, given the incentives of the choice situation (Carson and Groves 2007, p.183). On the other hand, inconsequential survey questions have no effect on something the respondent cares about. Any response to an inconsequential question will therefore give the respondent the same (expected) utility level, so we cannot make predictions about how the respondent should respond. The central tenet of the Carson and Groves papers is that hypothetical but consequential questions can have the same incentives as "real" questions and, if so, we should expect respondents to behave similarly whether the question is real or hypothetical but consequential.

[6] See Carson (2012), Hausman (2012), and Kling, Phaneuf, and Zhao (2012) for the latest round of debate.

Several studies have indeed found that respondents who believed their responses to be consequential behaved statistically differently from respondents who did not believe their responses to be consequential (Bulte et al. 2005; Landry and List 2007; Vossler and Evans 2009; Vossler, Doyon, and Rondeau 2012; Interis and Petrolia 2012). Further, Interis and Petrolia (2012) find that failing to control for consequentiality perceptions lowers the apparent construct validity of the instrument; respondents who believe the survey to be consequential are more sensitive to project attributes and behave consistently with scope predictions whereas respondents who do not believe the survey to be consequential exhibit behavior inconsistent with theoretical predictions.

In order to control for respondent perceptions of consequentiality, we asked respondents whether they believed the results of the survey would affect future policy in the estuary. We segment our results into two sets: our preferred results, based on the sample that excludes respondents who did not believe their responses to be consequential, and, for comparison and completeness, the full sample that includes them.[7] The latter is a "naïve" model that treats the choices of respondents who believe their responses to be inconsequential as representative of preferences even though there is no theoretical basis for such an assumption, given their perceptions of inconsequentiality.

Results

Tables 4 and 5 contain descriptions of the variables included in the analysis. Table 6 displays the means and standard errors of the individual-specific variables for both the binary

[7] The issue of consequentiality in this data set is dealt with more thoroughly in Interis and Petrolia (2012).

choice and multinomial choice models. Table 7 reports the parameter estimates for the binary-choice version of the survey. The significant variables are largely the same across the two sub-samples, and so we focus on the results of the consequential-respondents-only model. Importantly, the coefficient on bid is negative and significant. This indicates that the higher the bid price the respondent must pay to implement the project, the less likely he is to vote for its implementation. Resource users, defined as those who have visited or lived in the BTNE, are significantly more likely to vote in favor of the proposed restoration, and this accounts for the largest single effect of one variable on the probability of a yes vote: resource users are 16 percent more likely to vote yes. Respondents with greater confidence in federal and state governments are also more likely to be in favor of the project at 8 and 10 percent, respectively. People who rate themselves relatively more conservative are less likely to be in favor of the project (7 percent for a one-unit change in political rating). People who have made greater changes to their lifestyle for environmental reasons are more likely to be in favor of the project (8 percent for a one-unit change). Regarding demographic indicators, age and head-of-household are also significant.

Table 8 shows the parameter estimates for the multinomial-choice version of the survey. The significant individual-specific variables are similar to those in the binary-choice model, with two key exceptions: the first is that the BTNE visitor / resident variable is not significant, indicating no statistically-significant difference in the voting behavior of this group relative to resource non-users; and second, minorities and males are statistically less likely to vote for a program in the multinomial-choice setting.

The coefficients on the alternative-specific variables are all highly significant for the consequential respondents. These coefficients indicate whether the respondent is more likely to vote for an option with the specified attribute level than an option with the lowest level attribute, all else equal. Furthermore, we should expect the coefficients on the highest-level attributes to be greater in magnitude than those on the intermediate level attributes because, all else equal, we would expect a high level of the attribute to increase the probability that the respondent chooses that option more than an intermediate level of the attribute. This is true in the consequential-respondents-only results with the exception of the storm surge protection attribute. For storm surge protection, the coefficient on the high level is equal to that of intermediate level. This indicates that an intermediate or high level of this attribute increases the likelihood of the respondent voting for the program over the lowest level of these attributes, but that respondents do not derive additional utility beyond the intermediate level.

Increased fisheries productivity has the largest marginal effect on project choice (13 and 14 percent for intermediate and high levels, respectively), followed by increased storm surge protection (10 percent), and increased wildlife habitat (7 and 9 percent, respectively). Among individual-specific characteristics, confidence in Louisiana state government has the largest effect at 6 percent.

Comparing the results of the consequential-respondents-only and all-respondents, we find that the significant individual-specific variables are largely the same across the two sub-samples. However, more substantial differences are found for the choice-specific attributes. Although the coefficient signs, significance, and relative magnitudes are as expected for the consequential-respondents only model, the high level of wildlife habitat is only marginally significant and the high level of storm protection is not significant for the all-respondents model. This result highlights the fact that including respondents who do not find their responses to be consequential can lead to some counterintuitive results; it would be odd if people truly were more likely to vote for a program if it had the intermediate level of the attribute provided but not if it provided the highest level of the attribute. Thus, the empirical evidence supports our theoretically-based claim that we should have less confidence in the responses of individuals who do not perceive the survey as consequential. The results based on observations including these individuals fail basic reasonable preference assumptions, and this could be driven by the fact that the assumption on which the model is based – that respondents choose the alternative that maximizes their utility – fails for these respondents.

Table 9 reports the estimated WTP for the proposed program based on the binary-choice results. The numbers in brackets show the 95% confidence intervals. Recall that the binary-choice version proposed a program fixed at the intermediate levels of the attributes. In the top half, we differentiate WTP estimates according to whether the respondent is a user or a non-user of the estuary (where users are defined as those who have lived in or visited the estuary), and the bottom half contains the sample weighted mean WTP. Given that the sample is comprised of approximately 92 percent non-users, the weighted mean is closely aligned with the resource non-user estimates. Resource user WTP for the consequential-respondents-only subsample is estimated at $3,125 per household (with a confidence interval of $2029-$4825), approximately twice that of resource non-users (mean of $1,637 with confidence interval of $1271-$2242). Thus, while users of the estuary are predictably willing to pay more for wetland restoration, non-users still have a fairly high willingness to pay for restoration. This provides some evidence that Americans generally value Louisiana's wetlands. Overall, the sample-weighted mean WTP is estimated at $1,751 per household, with a confidence interval of $1382-$2396. For comparison, we also report an alternative estimate based on the Turnbull Lower Bound method (see Turnbull

1976; Cosslett 1982; Ayer *et al*. 1995). The Turnbull estimates are substantially lower, hovering closer to $1000 per household.

Table 10 reports the estimated WTP for the proposed program based on the multinomial-choice results. For the multinomial-choice survey, it is possible to derive value estimates for a program at various attribute levels. We report the value estimates for a program with all of the attributes at the lowest level, all of the attributes at the intermediate level, and all of the attributes at the highest level. We report estimates for both resource users and non-users, but keep in mind that the BTNE visitor / resident variable was not significant in this model, and so these difference should not be viewed as statistically different. Estimated WTP for resource users is $524, $971, and $1,018 per household for the proposed project at the low, intermediate, and high attribute level restoration programs, respectively, just slightly above those of resource non-users. The estimates based on the all-respondents model are slightly lower.

The estimates for the binary-choice model can be directly compared to those of the multinomial-choice model for the intermediate scale program. Although the regression-based binary-choice model estimates are substantially higher, the Turnbull estimates are fairly consistent with the multinomial-choice model based estimates.

As mentioned earlier, one of the advantages of a multinomial-choice survey is that it is possible to derive value estimates for incremental changes in the attribute levels. This allows the analyst to identify the specific contribution to overall WTP of a particular attribute, and to identify the relative importance of the various attributes. The bottom half of Table 10 shows these value estimates. The willingness to pay values indicate how much a household is willing to pay for the specified level of the attribute relative to the lowest level of the attribute. Comparing across attributes, results indicate that increases in fisheries productivity make the largest contribution to overall WTP, followed by improvements in storm protection, followed by increases in wildlife habitat. Thus, we estimate that respondents are willing to pay an average of \$189 per household for an *increase* in fisheries productivity from the low level to the intermediate level, and \$204 per household for an increase from the low level to the high level, *all else equal*. These results also imply the WTP for an increase from the intermediate to the high level of fisheries productivity: \$204 - \$189 = \$15. Similarly, WTP for an increase in storm surge protection to the intermediate level is estimated at \$149, but WTP for a further increase is just an additional \$2. Finally, WTP for an increase in wildlife habitat to the intermediate level is \$109 per household, and an additional \$30 for a further increase to the high level. Thus, results indicate that although respondents are willing to pay additional dollars for improvements in wildlife habitat beyond the intermediate level, they do not appear to be willing to pay much, if anything, for improvements in either storm protection or fisheries productivity *above and beyond the intermediate level*.

Conclusions

Wetland loss is occurring at a rapid rate all around the United States, but one of the fastest rates of loss is occurring in the Barataria-Terrebonne National Estuary, south of New Orleans. Coastal wetlands provide many benefits to humans and the natural world including protection from storms, breeding and spawning grounds for many important commercial and recreational fish species, habitat for birds, small mammals, and other wildlife, and a location for fishing, birding, and other recreational activities. Although some have begun referring to Louisiana’s coastal wetlands as “America’s wetlands” there have not yet been any studies assessing whether Americans broadly, and in particular those geographically far removed from the wetlands, value them. Previous value studies of Louisiana's wetlands have sampled only from within the state of Louisiana. Ours is the first nation-wide value study. Also, although several smaller-scale wetland restoration programs have been implemented in coastal Louisiana, our proposed programs restore much more wetland area, roughly fifty percent of the land lost in the area since 1956 (about 375 square miles).

The programs we proposed differed by the percentage of restored land that would be suitable for wildlife habitat, the percentage of residents in the area who would receive improved protection from storm surge, and the percentage increase in harvest of key Gulf of Mexico commercial fish species. We find that the general U.S. population is willing to pay for restoration. The results of the binary-choice model further show that respondents who had lived in or visited the estuary are willing to pay significantly more for wetland restoration than are people who had not lived in or visited the estuary. For an intermediate-scale program in which 50% of restored land was suitable for wildlife, 30% of respondents received improved storm protection, and harvest levels increased by 15%, we estimated that the average U.S. household is willing to pay roughly between $700 and $2800, with resource-using households willing to pay substantially more.

Our study involved the use of a multinomial choice survey, one of the advantages of which is that it can be used to estimate the values of changes in various attributes of the program. We found that the largest share of total willingness to pay for the program came from the desirability of increases in fisheries productivity (valued at between roughly $100 and $360 for the intermediate-scale program), followed by the desirability of protection from storms ($80 to $245), and wildlife habitat ($35 to $210).

In addition to being a resource user, several other factors increase the probability that a respondent is willing to pay to implement the proposed program. Older respondents, respondents who considered themselves more politically liberal, respondents who had made more lifestyle changes in the past for environmental reasons, and respondents who had greater confidence in federal and Louisiana State governments to implement the programs were more likely to vote in their favor.

Before closing, we wish to provide some simple comparisons to estimates in the existing literature as well as to estimated costs of restoration. First, we find that our value estimates are in line with those in the existing literature, keeping in mind that value estimates vary widely (see Woodward and Wui 2001). Our estimates correspond to a value of roughly $0.01 per person per acre of wetland. Putting estimates into January 2012 dollars, Bergstrom et al. (1990) and Petrolia, Moore, and Kim (2011) find estimates lower than ours ($0.0002 and $0.001, respectively) whereas Udziela and Bennett (1997) and Bauer, Cyr, and Swallow (2004) find estimates higher than ours ($1.25 and $0.60, respectively).

Given that our estimates are consistent with those found by other researchers in independent studies, we wish next to provide estimates of total value. Using the U.S. Census Bureau (2010) estimate of the number of households in the U.S. (roughly 115,000,000), this represents a total value of the intermediate-scale program of between $86 and $322 trillion.[8] The lower bound of our benefits estimate, $86 trillion, is still two orders of magnitude higher than the most recent, and by far the largest, estimate of restoration cost of $100 billion (Graves 2009).

[8] Alternatively, one could use the number of U.S. taxpaying households, but this number is actually slightly larger, at 142,823,000 for 2010 (U.S. Census Bureau 2012), so the estimated total WTP would be even larger.

Furthermore, our estimate, strictly speaking, applies only to our study area, the Barataria-Terrebonne National Estuary, which comprises only a fraction of the total Louisiana coast on which the above cost estimate is based. Thus, even if one discounts our estimates further for a variety of reasons, it is difficult to argue that the benefits do not justify the costs of restoration. Thus, our results certainly give credence to the claim that Louisiana is “America’s Wetland”.

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Table 1
Attribute Levels and Descriptions*

	Action Alternatives: *50% of lost land restored*			***No action alternative (SQ):*** Land loss expected *to continue at 4,500 to 7,100 acres per year*
	Low	*Medium*	*High*	
Wildlife Habitat: x% of restored land suitable as habitat	25%	50%	75%	No additional habitat and current habitat expected to decline
Storm surge protection: improved protection for x% of residents	5%	30%	50%	No improvement and current habitat expected to decline
Commercial fisheries harvest*:* x% higher harvest levels	Maintains current harvest levels	15%	30%	No improvement and current harvest levels expected to decline
Bid: $x one-time tax	$25, $90, $155, $285, $545, $925, $1305*, $2065*, $2825*			$0

* All non-price attributes set to the medium level for the binary-choice version. Prices with asterisks were used in the binary-choice version only.

Table 2
Comparison of the Sample, Regression Sub-Sample, and Population

			Regression Sub-Sample	
	Civilian Noninstitutionalized Population, 18+*	Full Sample	All respondents	Consequential Respondents Only
N =	230,890,000	3,464	2,477	1,700
Age				
18-44	0.48	0.40	0.40	0.40
45-64	0.35	0.41	0.41	0.40
65+	0.17	0.19	0.18	0.19
Education				
High school or below	0.43	0.38	0.32	0.33
Some college	0.26	0.29	0.30	0.29
Bachelor's degree or higher	0.30	0.33	0.38	0.38
Ethnicity				
White, non-Hispanic	0.67	0.75	0.79	0.77
Black, non-Hispanic	0.12	0.09	0.08	0.09
Hispanic	0.14	0.10	0.08	0.08
Other, non-Hispanic	0.07	0.06	0.06	0.06
Gender: Male	0.49	0.49	0.51	0.48
Metro Residents	0.83	0.84	0.84	0.84
Internet Access	0.74	0.78	0.81	0.80

* Source: Current Population Survey (Bureau of Labor Statistics 2012)

Table 3
Responses to General Questions Regarding Familiarity with Study Area and Concern about Losses

How familiar are you with the wetland and barrier island loss issue in coastal Louisiana?

	Proportion
Very familiar	0.03
Somewhat familiar	0.3
Not at all familiar	0.66
Refused	0.01

How familiar are you with the Barataria-Terrebonne Estuary?

	Proportion
I have visited or lived in the area.	0.06
I have never visited or lived in the area, but have heard of it.	0.19
I have never heard of it.	0.74
Refused	0.01

Overall, how concerned are you about these changes in the Lower Barataria-Terrebonne Estuary?

	Proportion
Very concerned	0.14
Concerned	0.34
Mildly concerned	0.34
Not at all concerned	0.17
Refused	0.01

Table 4

Multiple Regression Model Individual-Specific Independent Variable Names and Descriptions

Variable Name	Type	Description
Dependent Variable		
Vote	Binary	= 1 if vote for alternative, = 0 otherwise
Individual-specific Variables		
BTNE Visitor / Resident	Binary	= 1 if visited or resides in BTNE, = 0 otherwise
Non-taxpayer	Binary	= 1 if did not file 2010 federal tax return
Income	Ordered Cat.	Household income; 19 categories, ranging from = 1 (Less than $5,000) to 19 ($175,000 or more)
Head of Household	Binary	= 1 if respondent is head of household, = 0 otherwise
Age	Continuous	respondent age in years
Minority	Binary	= 1 if minority race, = 0 otherwise
Male	Binary	= 1 if male, = 0 otherwise
Confidence in Fed Gov.	Binary	= 1 if has at least some confidence in federal agencies to carry out project, = 0 otherwise
Confidence in LA Gov.	Binary	= 1 if has at least some confidence in Louisiana state agencies to carry out project, = 0 otherwise
Politically Conservative	Ordered Cat.	political preference, ranging from 1 (very liberal) to 7 (very conservative)
Oilspill	Binary	= 1 if followed DWH oil spill at least somewhat closely, = 0 otherwise
Green	Ordered Cat.	= -1 if has made no changes in behavior for environmental reasons, = 0 if minor changes, = 1 if major changes

Table 5
Multiple Regression Model Alternative-Specific Variable Names and Descriptions

Variable Name	Type	Description
Bid	Continuous	offered project cost, in dollars
Wildlife Habitat- Intermediate*	Binary	= 1 if wildlife habitat attribute level specified as "50% of restored land suitable as habitat", = 0 otherwise
Wildlife Habitat - High*	Binary	= 1 if wildlife habitat attribute level specified as "75% of restored land suitable as habitat", = 0 otherwise
Storm Protection - Intermediate*	Binary	= 1 if storm protection attribute level specified as "Improved protection for 30% of residents", = 0 otherwise
Storm Protection - High*	Binary	= 1 if storm protection attribute level specified as "Improved protection for 50% of residents", = 0 otherwise
Fisheries Productivity - Intermediate*	Binary	= 1 if fisheries productivity attribute level specified as "15% higher harvest levels", = 0 otherwise
Fisheries Productivity - High*	Binary	= 1 if fisheries productivity attribute level specified as "30% higher harvest levels", = 0 otherwise

* Appears in multinomial-choice model only. Note that the low levels of the attributes serve as the bases.

Table 6
Mean and Standard Errors of Regression Model Variables

	Binary-choice Sample				Multinomial-choice Sample			
	Consequential Respondents Only		All Respondents		Consequential Respondents Only		All Respondents	
	N = 652		N = 959		N =1048		N = 1518	
Variable Name	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Vote (dep. variable)	0.67		0.59		0.85*		0.78*	
Bid	657.69	763.86	673.04	770.84	*		*	
BTNE Visitor / Resident	0.08		0.06		0.08		0.08	
Non-taxpayer	0.10		0.11		0.12		0.11	
Income	12.30	4.21	12.34	4.24	12.28	0.33	12.52	4.32
Head of Household	0.83		0.82		0.81		0.82	
Age	48.76	16.92	48.49	16.65	48.95	17.13	48.88	16.65
Minority	0.23		0.22		0.22		0.21	
Male	0.50		0.51		0.48		0.50	
Confidence in Fed Gov.	0.41		0.36		0.48		0.42	
Confidence in LA Gov.	0.56		0.49		0.58		0.49	
Politically Conservative	4.15	1.49	4.21	1.50	4.13	1.50	4.20	1.52
Oilspill	0.91		0.89		0.90		0.89	
Green	0.06	0.56	-0.04	0.58	0.06	0.58	-0.004	0.59

* Proportion of respondents voting for one of the action alternatives. In the interest of space, we do not present the descriptive statistics for bid and other alternative-specific attributes in the multinomial-choice model because there were many different proposed programs, each with its own distribution of attribute levels.

Table 7.
Multiple Regression Probit Model Results for Binary-choice Valuation Data

	Consequential Respondents Only				*All Respondents*			
		N = 652				*N = 959*		
	Coef.		Std. Err.	Marg. Effect	Coef.		Std. Err.	Marg. Effect
Bid	-0.0004	***	0.0007	-0.0001	-0.0004	***	0.0006	-0.0001
BTNE Visitor / Resident	0.61	***	0.23	0.16	0.54	***	0.19	0.16
Non-taxpayer	0.22		0.21	0.06	0.05		0.15	0.02
Income	-0.01		0.01	-0.003	-0.01		-0.01	-0.004
Head of Household	-0.36	**	0.18	-0.10	-0.23	*	0.13	-0.07
Age	0.01	***	0.003	0.003	0.008	***	0.003	0.003
Minority	0.15		0.14	0.04	0.19	*	0.11	0.06
Male	-0.01		0.11	-0.002	-0.04		0.09	-0.01
Confidence in Fed Gov.	0.26	**	0.13	0.08	0.43	***	0.10	0.14
Confidence in LA Gov.	0.37	***	0.12	0.11	0.38	***	0.09	0.13
Politically Conservative	-0.22	***	0.04	-0.07	-0.19	***	0.03	-0.06
Oilspill	0.30		0.19	0.09	0.18		0.14	0.06
Green	0.28	***	0.10	0.08	0.26	***	0.08	0.09
Constant	0.89	***	0.34		0.72	***	0.27	
Log-likelihood Value		-343.91				-550.84		
Likelihood Ratio Chi-sq(12)		138.93***				199.24***		
McFadden's Pseudo R-sq		0.17				0.15		

***, **, * indicates statistical significance at the p = 0.99, 0.95, and 0.90 levels, respectively.

Table 8.

Multiple Regression Conditional Logit Model Results for Multinomial-choice Valuation Data

	Consequential Respondents Only				*All Respondents*			
	N = 1048				*N = 1518*			
	Coef.		Std. Err.	Marg. Eff.	Coef.		Std. Err.	Marg. Eff.
Alternative-specific Variables								
Bid	-0.003	***	0.0004	-0.001	-0.002	***	0.0003	-0.001
Wildlife Habitat: Intermediate	0.30	***	0.11	0.07	0.27	***	0.09	0.07
Wildlife Habitat: High	0.38	***	0.14	0.09	0.21	*	0.11	0.05
Storm Protection: Intermediate	0.41	***	0.10	0.10	0.37	***	0.08	0.09
Storm Protection: High	0.41	**	0.16	0.10	0.15		0.14	0.04
Fisheries Productivity: Intermediate	0.52	***	0.13	0.13	0.53	***	0.11	0.13
Fisheries Productivity: High	0.56	***	0.15	0.14	0.47	***	0.13	0.12
Individual-specific Variables								
BTNE Visitor / Resident	0.18		0.30	0.01	0.13		0.27	0.01
Non-taxpayer	-0.05		0.20	-0.002	0.001		0.24	0.0001
Income	0.03		0.01	0.001	0.02		0.02	0.001
Head of Household	-0.49	*	0.23	-0.02	-0.23		0.20	-0.02
Age	0.02	***	0.19	-0.001	0.01	**	0.005	0.001
Minority	-0.58	**	0.22	-0.03	-0.32	*	0.18	-0.02
Male	-0.59	***	0.20	-0.03	-0.41	***	0.14	-0.03
Confidence in Fed Gov.	0.57	**	0.07	0.03	0.52	***	0.16	0.04
Confidence in LA Gov.	1.11	***	0.29	0.06	1.03	***	0.15	0.07
Politically Conservative	-0.04	***	0.17	-0.02	-0.40	***	0.05	-0.03
Oilspill	0.30		0.33	0.02	0.28		0.21	0.02
Green	0.39	**		0.02	0.52	***	0.12	0.04
Constant (Alt A)	1.13	*	0.51		1.10	**	0.43	
Constant (Alt B)	0.99	*	0.52		1.01	**	0.44	
Log-likelihood Value	-923.23				-1409.56			
Wald Chi-sq(18)	206.70***				316.91***			

***, **, * indicates statistical significance at the p = 0.99, 0.95, and 0.90 levels, respectively.

Table 9.
Estimated Means and Confidence Intervals (in brackets) of Willingness to Pay (WTP) Based on Binary-Choice Results

	Consequential Respondents Only	All Respondents
Resource Users*	$3,125 [2029, 4825]	$2,710 [1618, 4181]
Resource Non-Users	$1,637 [1271, 2242]	$1,184 [894, 1592]
Weighted Mean	$1,751 [1382, 2396]	$1,281 [989, 1708]
*Non-parametric Turnbull***	*$1026* *[955, 1096]*	*$973* *[916, 1031]*

* BTNE Visitors and Residents

** Provided for comparison; not based on regression results

Table 10
Estimated Means and Confidence Intervals (in brackets) of Willingness to Pay (WTP),
Based on Multinomial-Choice Results

Overall WTP

	Consequential Respondents Only			All Respondents		
	Low	Intermediate	High	Low	Intermediate	High
Resource Users*	$524	$971	$1,018	$388	$911	$757
	[241, 877]	[673, 1376]	[719, 1393]	[148, 679]	[643, 1282]	[470, 1038]
Resource Non-Users	$457	$904	$951	$331	$854	$700
	[319, 662]	[724, 1181]	[795, 1150]	[216, 476]	[692, 1086]	[534, 855]
Weighted Mean	$463	$909	$956	$335	$858	$704
	[321, 664]	[732, 1185]	[800, 1156]	[220, 479]	[696, 1093]	[542, 860]

WTP for Attribute Increments (Relative to Low Levels)

	Intermediate	High	Intermediate	High
Wildlife Habitat	$109	$139	$121	$92
	[37, 184]	[47, 212]	[46, 203]	[-7, 172]
Storm Protection	$149	$151	$165	$68
	[83, 225]	[44, 246]	[99, 245]	[-61, 165]
Fisheries Productivity	$189	$204	$237	$210
	[97, 309]	[106, 310]	[141, 359]	[111, 315]

* BTNE Visitors and Residents

Figure 1. Barataria-Terrebonne National Estuary (BTNE), Louisiana

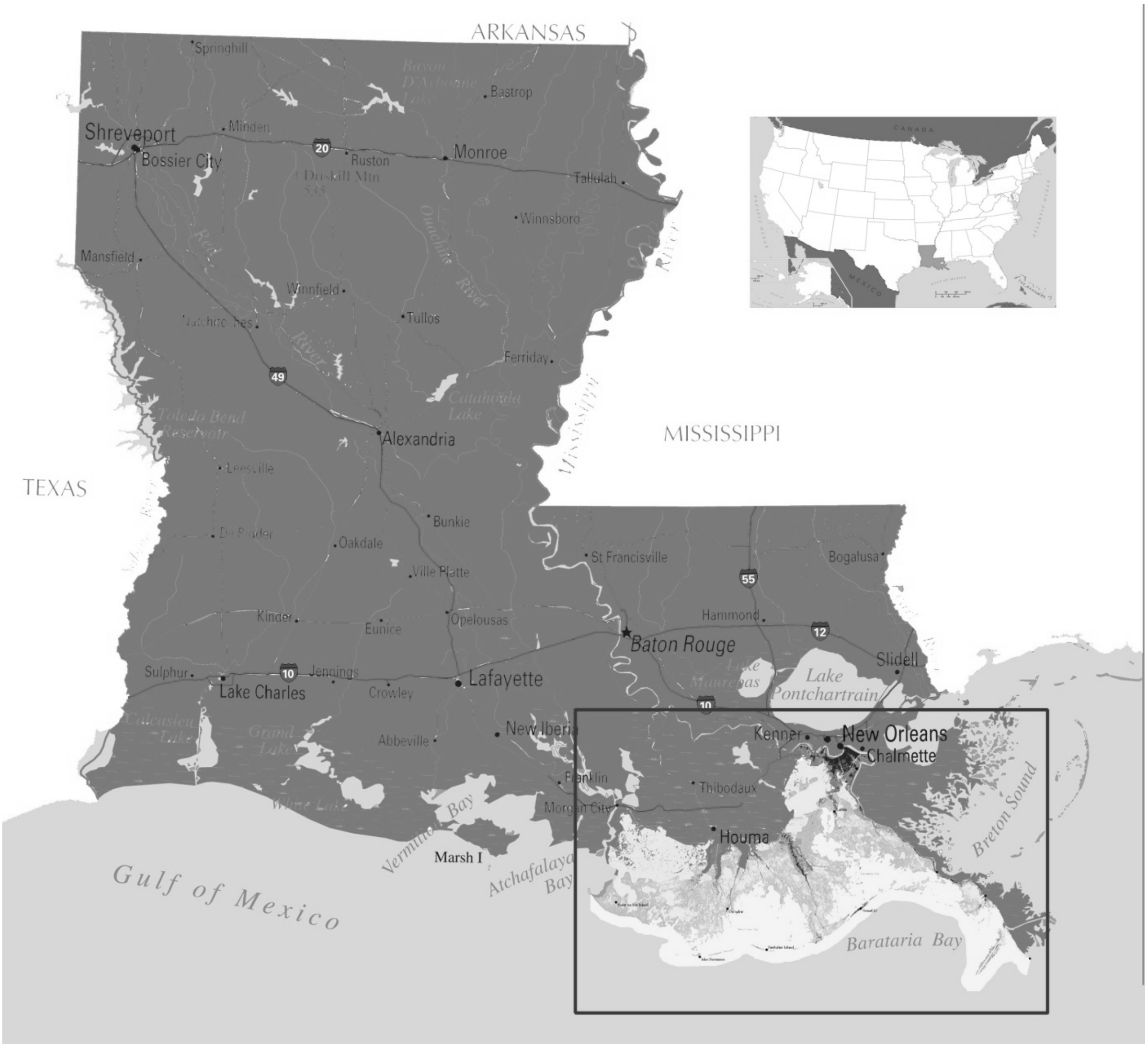

Figure 2. Example binary-choice valuation question.

	With Project: 50% of lost land restored	**Without Project (No Action):** Land loss expected to continue at 4,500 to 7,100 acres per year
Wildlife habitat	50% of restored land suitable as habitat	No additional habitat and current habitat expected to decline
Storm surge protection	Improved protection for 30% of residents	No improvement and current protection expected to decline
Commercial fish harvest	15% higher harvest levels	No improvement and current harvest levels expected to decline
Share of total cost to your household (one-time tax)	$925	$0
I prefer:	☐	☐

I prefer not to vote: ☐

Figure 3. Example multinomial choice set.

	Project A: 50% of lost land restored	**Project B: 50% of lost land restored**	**No Action: Land loss expected to continue at 4,500 to 7,100 acres per year**
Wildlife habitat	25% of restored land suitable as habitat	50% of restored land suitable as habitat	No additional habitat and current habitat expected to decline
Storm surge protection	Improved protection for 5% of residents	Improved protection for 30% of residents	No improvement and current protection expected to decline
Commercial fish harvest	Maintains current harvest levels	15% higher harvest levels	No improvement and current harvest levels expected to decline
Share of total cost to your household (one-time payment)	$155	$285	$0
I prefer:	☐	☐	☐

☐ **I prefer not to vote**