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

Author(s): Daniel R. Petrolia, Matthew G. Interis, and Joonghyun Hwang
Source: *Marine Resource Economics*, Vol. 29, No. 1 (March 2014), pp. 17-37
Published by: The University of Chicago Press
Stable URL: http://www.jstor.org/stable/10.1086/676289
Accessed: 05/06/2014 17:35

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

Daniel R. Petrolia, Matthew G. Interis, and Joonghyun Hwang, *Mississippi State University*

ABSTRACT

A nationwide survey was conducted to estimate welfare associated with large-scale wetland restoration in coastal Louisiana. Binary- and multinomial-choice survey instruments were administered via Knowledge Networks, using the latter to estimate willingness to pay (WTP) 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. Mean household WTP, in the form of a one-time tax, is estimated to be \$909 (confidence interval \$732–\$1,185), with resource users being willing to pay substantially more. This figure implies a mean aggregate willingness to pay of \$105 billion (confidence interval \$84–\$136 billion) in excess of the State of Louisiana's estimated \$50 billion cost for a statewide restoration program similar to the hypothetical restoration in this study.

Key words: Choice experiment, consequentiality, contingent valuation, Knowledge Networks, Louisiana, non-market valuation, non-use value, use value, wetlands.
JEL Codes: Q51, Q57.

INTRODUCTION

The wetlands of coastal Louisiana (US) account for 37% of the total estuarine herbaceous marshes in the continental United States (US), 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 50% of the nation's oil refining capacity is produced

Daniel R. Petrolia (corresponding author), is an associate professor, **Matthew G. Interis** is an assistant professor, and **Joonghyun Hwang** is a research associate, Department of Agricultural Economics, Mississippi State University, Box 5187, Mississippi State, MS 39762 USA (email: petrolia@agecon.msstate.edu, interis@agecon.msstate.edu, and Jhh240@msstate.edu, respectively).

The authors express their gratitude to the journal's editor, Martin Smith, an associate editor, and three anonymous reviewers for suggestions that greatly improved the manuscript. The authors also express their sincere gratitude to Kerry St. Pe and all the staff of the Barataria-Terrebonne National Estuary Program for providing valuable information and their assistance in improving the quality of the survey instrument. This research was conducted under award NA06OAR4320264 06111039 to the Northern Gulf Institute by the NOAA Office of Ocean and Atmospheric Research, U.S. Department of Commerce, and supported by the USDA National Institute of Food and Agriculture, Multistate Project W–3133 "Benefits and Costs of Natural Resources Policies Affecting Ecosystem Services on Public and Private Lands" (Hatch Project MIS–033140).

Received February 1, 2013; Accepted October 17, 2013; Published online April 7, 2014. http://dx.doi.org/10.1086/676289

Marine Resource Economics, volume 29, number 1.
0738-1360/2014-0004\$10.00

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] Between 1932 and 2010, coastal Louisiana experienced a net loss in land area of approximately 1,883 square miles, accounting for about 90% of the total wetland loss in the lower 48 states (Couvillion et al. 2011). 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 2012). 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; State of Louisiana 2012).

Consequently, and in an effort to garner support for restoration[3] 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, they focused only on their value to resource users (Bergstrom et al. 1990; Farber 1996; Costanza et al. 2008). 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 that Louisiana's wetlands truly are "America's" was lacking. Landry et al. (2011) were the first to address this gap. They administered a choice experiment to households in New Orleans as well as outside of Louisiana on their WTP for programs to better prepare New Orleans for storms. The proposed choice sets included increased flood protection (via augmented levees), coastal restoration, and improved transportation infrastructure attributes. However, respondents were not provided any details regarding either the scale (i.e., acreage) or anticipated benefits of the proposed restoration.[4] It is therefore difficult to interpret and apply the reported welfare estimates. To improve upon the efforts begun by Landry et al., we administer a nationwide survey focusing specifically on a proposed large-scale coastal restoration program for Louisiana that provides respondents with extensive information regarding historical losses, project scale, and anticipated benefits.

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?* (2) *What specific ecosystem services provided by Louisiana's coastal wetlands are the key drivers of U.S. households' willingness to pay (WTP), 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

1. Losses are partly due to natural phenomena, such as sea level rise, subsidence, erosion, saltwater intrusion, and tropical storm impacts, but also 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 2007).

2. Estimated loss rates vary. Coreil and Barrett-O'Leary (2004) report an average loss of 25 square miles per year since 1930. The most recent estimate is a loss rate of 16.57 square miles per year for the period 1985–2010 (Couvillion et al. 2011).

3. The National Research Council (1992) defines restoration as the "return of an ecosystem to a close approximation of its condition prior to disturbance." The term as used in this article does not quite adhere to this definition because the restoration proposed herein would achieve only a partial return of land mass and the associated services.

4. The authors state that "These additional benefits [of coastal restoration] were not noted in the survey, but we suspect that many coastal residents are aware of these additional benefits." (p. 995).

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.[5] 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 14 Atlantic coast states (and Washington, DC) 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. Landry et al. (2011) and the present study are then, to our knowledge, the only US wetland valuation studies whose samples are drawn nationally and comprised largely of respondents that are both non-users and geographically very far removed from the study site.

Furthermore, although several studies provide welfare estimates for specific ecosystem services provided by wetlands, this is the only study of Louisiana's wetlands that utilizes the multinomial choice-experiment method to obtain such estimates. We implement a split-sample design to administer both a binary-choice and multinomial-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 a large-scale (234,000 acre) coastal wetland and barrier island restoration in Louisiana's Barataria and Terrebonne estuaries (BTNE), located just south and west of New Orleans (figure 1). The survey proposed to respondents one or more wetland and barrier island restoration programs and asked them if they would hypothetically be willing to pay a specified amount to implement one of the proposed restoration programs. The survey provided extensive detail regarding what wetlands are, what benefits they provide, and the scale and scope of the proposed restoration project. It explained 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 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, which served as choice attributes: improved wildlife habitat, mea-

5. 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,b,c); McVittie and Moran (2010); Milon and Scrogin (2006); Petrolia and Kim (2009); Petrolia, Moore, and Kim (2011); and Woodward and Wui (2001).

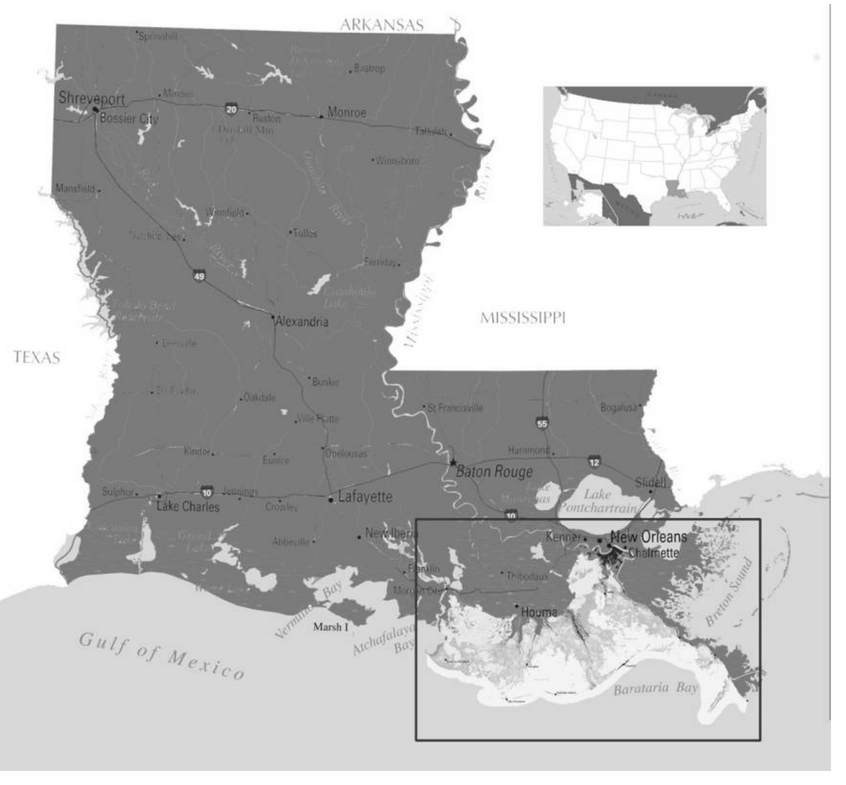

Figure 1. Barataria-Terrebonne National Estuary (BTNE), LA

sured 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. The complete text of the scenario description can be found in the online appendix.

Two versions of the survey were constructed. In the first, respondents were presented with a single restoration program and 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,[6] 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.)

6. Not all wetland construction projects result in the same quality of habitat, which depends on location, elevation, sediment type, and a host of other factors. We found, via focus groups and pretesting, that expressing this variation in terms of percentage of land suitable as habitat was preferred in terms of simplicity and clarity.

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, $1,305*, $2,065*, $2,825*			$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.

Respondents were told that these benefits were expected to last for approximately 50 years. The price to the respondent for the project took on one of nine randomly assigned dollar values {$25, 90, 155, 285, 545, 925, 1,305, 2,065, 2,825}. 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).[7] 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 US. Knowledge Networks sampled households from its KnowledgePanel, a probability-based web panel designed to be representative of the US. Prior to administering the survey instrument, the authors met with staff at the Barataria-Terrebonne National Estuary Program center in Thibodaux, LA, 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

7. 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 and presented each respondent with exactly one choice set to evaluate (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). This also facilitates comparison with the results of the binary-choice version.

Once again, here are the expected outcomes and project cost. The project would be completed in 5 years and the benefits are expected to last for 50 years. The No Action option means that the restoration project would not be implemented. For this advisory vote, assume that the choice receiving the most votes would be adopted. Please indicate your choice at the bottom of the table below.

	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 2. Example Binary-Choice Question

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 versions, respectively.

DATA AND EMPIRICAL METHODS

DATA OVERVIEW

The sample demographics match those of the U.S. population closely. With the exception of slight over-representation of white, educated, and internet-accessed respondents, the sample was representative of the overall population. Refer to part B of the online appendix for the details of the comparison, including a comparison of the regression sub-samples (discussed below).

The survey elicited information regarding respondent familiarity with the study area and overall concern for the wetland loss problem. Roughly two-thirds of the sample was not at all familiar with the wetland loss issue in Louisiana, and about one-third was at least somewhat familiar. About three-quarters 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

Once again, here are the available options. Both Project A and Project B would be completed in 5 years and the benefits are expected to last for 50 years. The No Action option means that neither restoration project would be implemented. For this advisory vote, assume that the choice receiving the most votes would be adopted. Please indicate your choice at the bottom of the table below.

	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**

Figure 3. Example Multinomial-Choice Question

Louisiana is indeed "America's Wetland," it is not because people are familiar with it. However, over 80% of respondents indicated that they were at least mildly concerned about wetland losses in Louisiana, with 17% not at all concerned. Refer to part C of the online appendix for the details of these responses.

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:

$$U_{ij} = \alpha_j + \boldsymbol{\beta}'\boldsymbol{x}_{ij} + \boldsymbol{\delta}_j' z_i + \varepsilon_{ijk}, \tag{1}$$

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 (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 (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 WTP for various scales of restoration as well as the average WTP for incremental changes in the project attributes (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 (Carson 2012; Hausman 2012; Kling, Phaneuf, and Zhao 2012; and Haab et al. 2013). 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. 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.

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; Herriges et al. 2010; Landry and List 2007; Vossler and Evans 2009; Vossler, Doyon, and Rondeau 2012; Interis and Petrolia 2013). Further, Interis and Petrolia (2013) 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 elicited responses to the following two questions:

> *When voting, how important did you think <u>your vote</u> would be in determining which option received the most votes?*
>
> a) *Very important*
> b) *Somewhat important*
> c) *Not important*
> d) *I didn't really think about it.*
>
> *How likely do you think it is that the results of <u>this survey</u> will shape the direction of future policy in the Lower Barataria-Terrebonne Estuary?*

a) *Very likely*
b) *Somewhat likely*
c) *Unlikely*
d) *I don't know.*

The first question, above, elicits respondent perceptions about the importance of *their vote, in particular relative to the overall outcome*, whereas the second question elicits respondent perceptions about the likelihood that the survey itself will actually affect policy. We categorized respondents who responded "a" or "b" to at least *one* of the above questions as "consequential," and those who responded "c" or "d" to *both* questions as "inconsequential." We segment our results into two sets: our preferred results, based on the sample that excludes respondents categorized as "inconsequential," and, for comparison and completeness, the full sample that includes them.[8] 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 apparent perceptions of inconsequentiality.

RESULTS

Table 2 contains descriptions of the variables included in the analysis. Table 3 displays the means and standard deviations of the individual-specific variables for both the binary-choice and multinomial-choice models. Table 4 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. This accounts for the largest single effect of one variable on the probability of a yes vote: resource users are 16% 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%, respectively. People who rate themselves relatively more conservative are less likely to be in favor of the project (7% 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% for a one-unit change). Regarding demographic indicators, age and head-of-household are also significant.

Table 5 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.

8. The issue of consequentiality in this data set is dealt with more thoroughly in Interis and Petrolia (2013).

Table 2. Multiple Regression Model Variable Names and Descriptions

Variable	Description
Dependent Variable	
Vote	= 1 if vote for alternative, = 0 otherwise
Alternative-specific Attributes	
Bid	offered project cost, in dollars
Wildlife habitat-intermediate*	= 1 if wildlife habitat attribute level specified as "50% of restored land suitable as habitat," = 0 otherwise
Wildlife habitat-high*	= 1 if wildlife habitat attribute level specified as "75% of restored land suitable as habitat," = 0 otherwise
Storm protection-intermediate*	= 1 if storm protection attribute level specified as "Improved protection for 30% of residents," = 0 otherwise
Storm protection-high*	= 1 if storm protection attribute level specified as "Improved protection for 50% of residents," = 0 otherwise
Fisheries productivity-intermediate*	= 1 if fisheries productivity attribute level specified as "15% higher harvest levels," = 0 otherwise
Fisheries productivity-high*	= 1 if fisheries productivity attribute level specified as "30% higher harvest levels," = 0 otherwise
Individual-specific Variables	
BTNE visitor/resident	= 1 if visited or resides in BTNE, = 0 otherwise
Non-taxpayer	= 1 if did not file 2010 federal tax return
Income	Household income: 19 categories, ranging from = 1 (Less than $5,000) to 19 ($175,000 or more)
Head of household	= 1 if respondent is head of household, = 0 otherwise
Age	respondent age in years
Minority	= 1 if minority race, = 0 otherwise
Male	= 1 if male, = 0 otherwise
Confidence in fed gov.	= 1 if has at least some confidence in federal agencies to carry out project, = 0 otherwise
Confidence in LA gov.	= 1 if has at least some confidence in LA state agencies to carry out project, = 0 otherwise
Politically conservative	political preference, ranging from 1 (very liberal) to 7 (very conservative)
Oilspill	= 1 if followed DWH oil spill at least somewhat closely, = 0 otherwise
Green	= –1 if has made no changes in behavior for environmental reasons, = 0 if minor changes, = 1 if major changes

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

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 no less than those on the intermediate-level attributes because, all else equal, we would expect a high level of the attribute to have a non-decreasing effect on the probability that the respondent chooses that option relative to the 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.

Table 3. Mean and Standard Deviations of Regression Model Variables

	Binary-choice Sample				Multinomial-choice Sample			
	Consequential Respondents Only N = 652		All Respondents N = 959		Consequential Respondents Only N =1,048		All Respondents N = 1,518	
Variable	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 4. Multiple Regression Probit Model Results for Binary-choice Valuation Data

	Consequential Respondents Only N = 652			All Respondents 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 5. Multiple Regression Conditional Logit Model Results for Multinomial-choice Valuation Data

	Consequential Respondents Only N = 1,048			All Respondents N = 1,518		
	Coef.	Std. Err.	Marg. Effect	Coef.	Std. Err.	Marg. Effect
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			−1,409.56	
Wald Chi-sq (18)		206.70***			316.91***	

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

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

Comparing the results of the consequential-respondents-only and all-respondents models, we find that the significant individual-specific variables are largely the same across the two subsamples. 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 6 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% 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 $2,029–$4,825), approximately twice that of resource non-users (mean of $1,637 with a confidence interval of $1,271–$2,242). Thus, while users of the estuary are predictably willing to pay more for wetland restoration, non-users still have a fairly high WTP 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 $1,382–$2,396. For comparison, we also report an alternative estimate based on the Turnbull Lower Bound method (Ayer et al. 1955; Cosslett 1982; Turnbull 1976). The Turnbull estimates are substantially lower, hovering closer to $1,000 per household.

Table 7 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, so this 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 levels, respectively; just slightly above those of resource non-users. The estimates based on the all-respondents model are slightly lower.

Table 6. Estimated Means and Confidence Intervals (in brackets) of WTP Based on Binary-Choice Results

	Consequential Respondents Only	All Respondents
Resource Users*	$3,125 [2,029, 4,825]	$2,710 [1,618, 4,181]
Resource Non-Users	$1,637 [1,271, 2,242]	$1,184 [894, 1,592]
Weighted Mean	$1,751 [1,382, 2,396]	$1,281 [989, 1,708]
Non-parametric Turnbull**	$1,026 [955, 1,096]	$973 [916, 1,031]

* BTNE visitors and residents.
** Provided for comparison; not based on regression results.

Table 7. Estimated Means and Confidence Intervals (in brackets) of WTP, Based on Multinomial-Choice Results

	Overall WTP					
	Consequential Respondents Only			All Respondents		
	Low	Intermediate	High	Low	Intermediate	High
Resource Users*	$524 [241, 877]	$971 [673, 1,376]	$1,018 [719, 1,393]	$388 [148, 679]	$911 [643, 1,282]	$757 [470, 1,038]
Resource Non-Users	$457 [319, 662]	$904 [724, 1,181]	$951 [795, 1,150]	$331 [216, 476]	$854 [692, 1,086]	$700 [534, 855]
Weighted Mean	$463 [321, 664]	$909 [732, 1,185]	$956 [800, 1,156]	$335 [220, 479]	$858 [696, 1,093]	$704 [542, 860]
	WTP for Attribute Increments (Relative to Low Levels)					
		Intermediate	High		Intermediate	High
Wildlife habitat		$109 [37, 184]	$139 [47, 212]		$121 [46, 203]	$92 [−7, 172]
Storm protection		$149 [83, 225]	$151 [44, 246]		$165 [99, 245]	$68 [−61, 165]
Fisheries productivity		$189 [97, 309]	$204 [106, 310]		$237 [141, 359]	$210 [111, 315]

* BTNE visitors and residents.

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 7 shows these value estimates. The WTP 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

Although some have begun referring to coastal Louisiana as "America's Wetland," hard evidence as to the validity of this claim was lacking. In an effort to improve upon the efforts begun by Landry et al. (2011), we administered a nationwide survey focusing specifically on a proposed large-scale coastal restoration program for Louisiana that provided respondents with extensive information regarding historical losses, project scale, and anticipated benefits.

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. 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 $2,800. Furthermore, the results show that respondents who had lived in or visited the estuary are willing to pay significantly 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 WTP 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.

Using the WTP per household for the intermediate-scale restoration (consequential respondents only, weighted-mean estimates: mean of $909 and confidence interval of $732–$1,185) and the estimated number of households in the U.S. in 2011 (114,991,725, US Census Bureau 2011), our estimates imply a mean aggregate value of $105 billion, with a range of $84–$136 billion.[9] For comparison, table 8 presents estimates reported in previous stated-preference wetland restoration studies. Those specific to Louisiana are shown in the top half, and those specific to other locations are shown in the bottom half. The first thing to notice is that the scale of the Louisiana restoration studies are much larger than any of the other studies; thus, it is reasonable to expect that WTP per project would be larger for these projects.

The estimated WTP for coastal restoration in Landry et al. (2011), which is the most relevant study for comparison in terms of services being valued and sample population, is

9. Alternatively, one could use the number of U.S. tax returns filed in 2010, but this number is slightly larger, at 142,823,000 (US Census Bureau 2012), so the estimated total WTP would be even larger.

Table 8. Comparison of WTP Estimates of Wetland Restoration

	Study Area	Survey Year	Project Scale (acres)	Reported (nominal) Mean WTP per Household		Present Value of Mean WTP per Household, Inflation Adjusted (2011$)*	
				One-time ($)	Annually ($)	Per Project ($)	Per Project Acre ($)
Present Study	LA	2011	234,000	973		973	0.004
Landry et al. (2011)†	LA	2007	N/A	103		112	
				552		599	
Petrolia and Kim (2011)	LA	2009	448,000		111	1,025	0.002
Farber (1996)	LA	1990	N/A		66	997	
Bergstrom et al. (1990)	LA	1986	1,600,000		360	6,492	0.004
Farber and Costanza (1987)	LA	1985	N/A		103	1,901	
Petrolia and Kim (2009)	MS	2008	2,338	144		150	0.064
Bauer, Cyr, and Swallow (2004)	RI	1997	83	40		56	0.673
Udziela and Bennett (1997)	CT	1996	N/A	61		88	
Bateman et al. (1995)	UK	1991	N/A		222‡	3,223	
Loomis et al. (1991)	CA	1989	58,000		154	2,454	0.042
Whitehead and Blomquist (1991)	KY	1989	5,000		11	175	0.035

* Assumes 10 years of payments and 3% discount rate for studies that reported annual WTP; inflation factors obtained from Bureau of Labor Statistics (2013).

† The first entry includes WTP for coastal restoration only; the second includes WTP for coastal restoration and flood protection.

‡ Assumes exchange rate for 1991 of £1 = $1.77, obtained from OANDA (2013).

much lower than the present study. However, it is unclear which of their welfare estimates is most comparable to ours. Their survey did not explain to respondents that one of the benefits of coastal wetland restoration is flood protection, which has been found to be a major (if not the leading) perceived benefit of coastal restoration in Louisiana and Mississippi (Farber 1987, 1996; Farber and Costanza 1987; Petrolia and Kim 2009, 2011). Additionally, the scale of restoration was not specified, nor did the flood protection specified in their survey extend beyond the city of New Orleans. On the other hand, our survey respondents were specifically told of the flood protection benefits of habitat restoration, and the scale of our project was specified to cover a large area, where areas other than New Orleans would potentially receive increased flood protection. If one considers their estimated WTP for both coastal restoration *and* flood protection, then their results are not drastically different from ours. In fact, their reported mean aggregate value for both coastal restoration and flood protection is $62 billion, with an upper bound of $92 billion. Furthermore, many of the previous studies report *annual* WTP, i.e., repeated payments that, when put in present value terms, are generally either comparable to, or exceed, our per-acre estimate.[10]

10. For the purposes of calculating net present value of these recurring payments, we assume a 10-year time frame, whereas annual WTP generally implies payments in perpetuity.

Turning to the cost side, the State of Louisiana released its most recent restoration proposal in the 2012 Coastal Master Plan (State of Louisiana 2012).[11] It assumes a budget of $50 billion over the next 50 years to restore between 348,800 and 549,760 acres statewide. Of this total budget, $17.2 billion is allocated to the "Southeast" region, which aligns closely with our study area. Although the Master Plan does not report acreage by region, using the proportion of the budget allocated to the Southeast region (39.25%) and assuming a constant cost per acre of restoration, then the amount of acres expected to be restored in the Master Plan's "Southeast" region would be between 136,904 and 215,781, which is very similar to the scale of restoration proposed in our scenario. Thus, it is reasonable to compare our estimated value of benefits to the Master Plan's estimated cost. What we find is that our estimated range of the value of benefits ($84–136 billion) clearly exceeds the estimated $17.2 billion cost of restoration for the study area, and even exceeds the full Master Plan budget of $50 billion.

With that said, two caveats are in order. First, our restoration scenario only allowed for commercial fisheries levels to improve or stay the same, whereas the State of Louisiana forecasts that the Master Plan would result in moderate declines in oyster habitat.[12] Second, our scenario assumed that the restoration would be completed in five years, whereas the Master Plan would spend $50 billion over a 50-year period, suggesting that both the associated benefits and costs would materialize over a longer time horizon, and implying that the present value cost of the Master Plan is substantially lower than $50 billion. Taking all of this into consideration, we conclude that our results give credence to the claim that Louisiana is "America's Wetland."

REFERENCES

America's Wetland Foundation. 2012. http://www.americaswetland.com/.

Ayer, M., H. D. Brunk, G. M. Ewing, W. T. Reid, and E. Silverman. 1955. "An Empirical Distribution Function for Sampling with Incomplete Information." *Annals of Mathematical Statistics* 26:641–7.

Barras, J. A., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2003. "Historical and Projected Coastal Louisiana Land Changes: 1978–2050." USGS Open File Report 03–334 (revised January 2004). http://www.nwrc.usgs.gov/special/NewHistoricalland.pdf.

Bateman, I. J., M. Cole, P. Cooper, S. Georgiou, D. Hadley, and G. L. Poe. 2004. "On Visible Choice Sets and Scope Sensitivity." *Journal of Environmental Economics and Management* 47:71–93.

Bateman, I. J., I. H. Langford, A. P. Jones, and G. N. Kerr. 2001. "Bound and Path Effects in Double and Triple Bounded Dichotomous Choice Contingent Valuation." *Resource and Energy Economics* 23: 191–213.

---

11. Two previous studies have proposed alternative restoration plans: *Coast 2050*, estimated to cost $14 billion (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998) and the *Louisiana Coastal Area* study, estimated to cost $1.9 billion (U.S. Corps of Engineers 2004). Restoration efforts funded by the Coastal Wetlands Planning, Protection, and Restoration Act of 1990, are ongoing, with federal funding since 1990 totaling $1.2 billion (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2012).

12. Declines in oyster habitat are expected to be due, most likely, to a lack of cultch material in many new areas that otherwise would become suitable for oyster cultivation. As for other species, it is anticipated that the Master Plan will result in significant gains for alligator, freshwater fisheries, and waterfowl, while maintaining levels of other coastal wildlife, shrimp, and saltwater fisheries. Of course, these are the expected overall effects. There will almost certainly be localized changes that are drastically different from the status-quo, as Caffey and Schexnayder (2002) point out, depending on species, location of structures, flow rates, and other environmental conditions.

Bateman, I. J., I. H. Langford, R. K. Turner, K. G. Willis, and G. D. Garrod. 1995. "Elicitation and Truncation Effects in Contingent Valuation Studies." *Ecological Economics* 12:161–79.

Bauer, D., N. Cyr, and S. Swallow. 2004. "Public Preferences for Compensatory Mitigation of Salt Marsh Losses: A Contingent Choice of Alternatives." *Conservation Biology* 18 (2):401–11.

Bergstrom, J., J. Stoll, J. Titre, and V. Wright. 1990. "Economic Value of Wetlands-Based Recreation." *Ecological Economics* 2:129–47.

Brander, L. M., R. J. G. M. Florax, and J. E. Vermaat. 2006. "The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature." *Environmental & Resource Economics* 33: 223–50.

Brouwer, R., I. H. Langford, I. J. Bateman, and R. K. Turner. 1999. "A Meta-analysis of Wetland Contingent Valuation Studies." *Regional Environmental Change* 1:47–57.

Bulte, E., S. Gerking, J. A. List, and A. de Zeeuw. 2005. "The Effect of Varying the Causes of Environmental Problems on Stated WTP Values: Evidence from a Field Study." *Journal of Environmental Economics & Management* 49:330–42.

Bureau of Labor Statistics. 2012. "Labor Force Statistics from the Current Population Survey: Demographics." http://www.bls.gov/cps/demographics.htm.

———. 2013. Consumer Price Index–All Urban Consumers (CPI–U). United States Department of Labor. ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt.

Caffey, R. H., K. Savoie, and M. Shirley. 2003. "Stewardship Incentives for Louisiana's Coastal Landowners." Interpretive Topic Series on Coastal Wetland Restoration in Louisiana, Coastal Wetlands Planning, Preservation and Restoration Act. National Sea Grant Library Publication #LSU–G–022. http://nsgl.gso.uri.edu/lsu/lsug03022.pdf.

Caffey, R. H., and M. Schexnayder. 2002. "Fisheries Implications of Freshwater Reintroductions." *Interpretive Topic Series on Coastal Wetland Restoration in Louisiana*, Coastal Wetland Planning, Protection, and Restoration Act (eds.), National Sea Grant Library Publication #LSU–G–02–003, 8 p. http://nsgl.gso.uri.edu/lsu/lsug02003.pdf.

Carlsson, F., P. Frykblom, and C. Liljenstolpe. 2003. Valuing Wetland Attributes: An Application of Choice Experiments. *Ecological Economics* 47:95–103.

Carson, R. T. 2012. "Contingent Valuation: A Practical Alternative when Prices Aren't Available." *Journal of Economic Perspectives* 26:27–42.

Carson, R. T., and T. Groves. 2007. "Incentive and Informational Properties of Preference Questions." *Environmental & Resource Economics* 37:181–210.

———. 2011. "Incentive and Information Properties of Preference Questions: Commentary and Extensions." In *International Handbook of Non-Market Environmental Valuation*, ed. J. Bennett, 300–21. Northampton, MA: Edward Elgar.

Christie, M., N. Hanley, J. Warren, K. Murphy, R. Wright, and T. Hyde. 2006. "Valuing the Diversity of Biodiversity." *Ecological Economics* 58:304–17.

Coastal Protection and Restoration Authority. 2007. *Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast*. Baton Rouge, LA.

———. 2012. "What's Causing the Crisis?" http://coastal.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=118.

Coreil, P., and M. Barrett-O'Leary. 2004. "Functions and Values of Wetlands in Louisiana." Louisiana Agricultural Center Publication #2519. Baton Rouge, LA.

Cosslett, S. R. 1982. "Distribution-Free Maximum Likelihood Estimator of the Binary Choice Model." *Econometrica* 51:765–82.

Costanza, R., O. Pérez-Maqueo, M. L. Martinez, P. Sutton, S. J. Anderson, and K. Mulder. 2008. "The Value of Coastal Wetlands for Hurricane Protection." *AMBIO: A Journal of the Human Environment* 37:241–8.

Couvillion, B. R., J. A. Barras, G. D. Steyer, W. Sleavin, M. Fischer, H. Beck, N. Trahan, B. Griffin, and D. Heckman. 2011. "Land Area Change in Coastal Louisiana from 1932 to 2010." U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000, 12 p.

Day, B., I. J. Bateman, R. T. Carson, D. Dupont, J. J. Louviere, S. Morimoto, R. Scarpa, and P. Wang. 2012. "Ordering Effects and Choice Set Awareness in Repeat-Response Stated Preference Studies." *Journal of Environmental Economics and Management* 63:73–91.

Day, B., and J.-L. P. Prades. 2010. "Ordering Anomalies in Choice Experiments." *Journal of Environmental Economics and Management* 59:271–85.

DeShazo, J. R. 2002. "Designing Transactions without Framing Effects in Iterative Question Formats." *Journal of Environmental Economics and Management* 43:360–85.

Desmond, J. M. 2005. "The Dying Louisiana Wetlands." *Janus Head* 8(2):485–92.

Dunbar, J. B., L. Britsch, and E. Kemp. 1992. "Land Loss Rates: Louisiana Coastal Plain. Technical Report GL–92–3, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Farber, S. 1987. "The Value of Coastal Wetlands for Protection of Property against Hurricane Wind Damage." *Journal of Environmental Economics and Management* 14:143–51.

———. 1996. "Welfare Loss of Wetlands Disintegration: A Louisiana Study." *Contemporary Economic Policy* 14:92–106.

Farber, S., and R. Costanza. 1987. "The Economic Value of Wetlands Systems." *Journal of Environmental Management* 24:41–51.

Greene, W. H. 2012. *Econometric Analysis*, 7th ed. Boston, MA: Prentice Hall.

Haab, T. C., M. G. Interis, D. R. Petrolia, and J. C. Whitehead. 2013. "From Hopeless to Curious? Thoughts on Hausman's 'Dubious to Hopeless' Critique of Contingent Valuation." *Applied Economic Perspectives and Policy* 35 (4):593–612.

Haab, T. C., and K. E. McConnell. 2002. *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation*. Northampton, MA: Edward Elgar.

Hausman, J. 2012. "Contingent Valuation: From Dubious to Hopeless." *Journal of Economic Perspectives* 26:43–56.

Herriges, J., C. Kling, C.-C. Liu, and J. Tobias. 2010. "What are the Consequences of Consequentiality?" *Journal of Environmental Economics & Management* 59:67–81.

Holmes, T. P., and K. J. Boyle. 2005. "Dynamic Learning and Context-Dependence in Sequential, Attribute-Based, Stated-Preference Valuation Questions." *Land Economics* 81:114–26.

Interis, M. G., and D. R. Petrolia. 2013. "Consequentiality Effects in Binary- and Multinomial-Choice Surveys." Working Paper, Department of Agricultural Economics, Mississippi State University, Mississippi State, MS.

Johnston, R. J., K. Segerson, E. T. Schultz, E. Y. Besedin, and M. Ramachandran. 2011. "Indices of Biotic Integrity in Stated Preference Valuation of Aquatic Ecosystem Services." *Ecological Economics* 70:1946–56.

Kazmierczak, R. F. 2001a. "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature." Staff Paper 2001–04, Natural Resource and Environment Committee, Department of Agricultural Economics & Agribusiness, Louisiana State University, Baton Rouge, LA.

———. 2001b. "Economic Linkages Between Coastal Wetlands and Hunting and Fishing: A Review of Value Estimates Reported in the Published Literature." Staff Paper 2001–03, Natural Resource and Environment Committee, Department of Agricultural Economics & Agribusiness, Louisiana State University, Baton Rouge, LA.

———. 2001c. "Economic Linkages Between Coastal Wetlands and Water Quality: A Review of Value Estimates Reported in the Published Literature." Staff Paper 2001–02, Natural Resource and Environment Committee, Department of Agricultural Economics & Agribusiness, Louisiana State University, Baton Rouge, LA.

Kling, C. L., D. J. Phaneuf, and J. Zhao. 2012. "From Exxon to BP: Has Some Number Become Better than No Number?" *Journal of Economic Perspectives* 26:3–26.

Krosnick, J. A. 1999. "Potential Drawbacks of Attribute-Based Stated Choice Studies: Comments on Layton and Brown (1998) and Swait, Adamowicz, and Louviere (1998)." Paper presented at the NOAA Workshop on the Application of Stated Preference Methods to Resource Compensation, Washington, DC.

Ladenburg, J., and S.,B. Olsen. 2008. "Gender-specific Starting Point Bias in Choice Experiments: Evidence from an Empirical Study." *Journal of Environmental Economics and Management* 56:275–85.

Landry, C. E., P. Hindsley, O. Bin, J. B. Kruse, J. C. Whitehead, and K. Wilson. 2011. "Weathering the Storm: Measuring Household Willingness-to-Pay for Risk-Reduction in Post-Katrina New Orleans." *Southern Economic Journal* 77:991–1013.

Landry, C. E., and J. A. List. 2007. "Using *Ex Ante* Approaches to Obtain Credible Signals for Value in Contingent Markets: Evidence from the Field." *American Journal of Agricultural Economics* 89:420–29.

Loomis, J., M. Hanemann, B. Kanninen, and T. Wegge. 1991. "Willingness to Pay to Protect Wetlands and Reduce Wildlife Contamination from Agricultural Drainage." In *The Economics and Management of Water and Drainage in Agriculture*, ed. A. Dinar and D. Zilberman, 411–29. Boston, MA: Kluwer Academic Publishers.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2012. "The 2012 Evaluation Report to the U.S. Congress on the Effectiveness of Coastal Wetlands Planning, Protection and Restoration Act Projects." http://lacoast.gov/reports/rtc/RTC_2012_1–18–13.pdf.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998. *Coast 2050: Toward a Sustainable Coastal Louisiana*. Baton Rouge, LA: Louisiana Department of Natural Resources.

Louisiana Department of Natural Resources. 2006. "America's Energy Corridor: Louisiana Serving the Nation's Energy Needs." Technology Assessment Division, Baton Rouge, LA.

McNair, B., J. Bennett, and D. Hensher. 2011. "A Comparison of Responses to Single and Repeated Discrete Choice Questions." *Resource and Energy Economics* 33:554–71.

McVittie, A., and D. Moran. 2010. "Valuing the Non-Use Benefits of Marine Conservation Zones: An Application to the UK Marine Bill." *Ecological Economics* 70:413–24.

Milon, J. W., and D. Scrogin. 2006. "Latent Preferences and Valuation of Wetland Ecosystem Restoration." *Ecological Economics* 56:162–75.

National Research Council. 1992. *Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy*. Committee on Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy. Washington, DC: National Academies Press.

OANDA. 2013. Historical Exchange Rates. http://www.oanda.com/currency/historical-rates/.

Petrolia, D. R. and T. Kim. 2009. "What are Barrier Islands Worth? Estimates of Willingness to Pay for Restoration." *Marine Resource Economics* 24:131–46.

———. 2011. Preventing Land Loss in Coastal Louisiana: Estimates of WTP and WTA. *Journal of Environmental Management* 92:859–65.

Petrolia, D. R., R. G. Moore, and T. Kim. 2011. "Preferences for Timing of Wetland Loss Prevention in Louisiana." *Wetlands* 31:295–307.

State of Louisiana. 2012. "Louisiana's Comprehensive Master Plan for a Sustainable Coast." Coastal Protection and Restoration Authority, Baton Rouge, LA.

Turnbull, B. 1976. "The Empirical Distribution Function with Arbitrarily Grouped, Censored, and Truncated Data." *Journal of the Royal Statistical Society* 38 B:290–95.

Udziela, M. K., and L. L. Bennett. 1997. "Contingent Valuation of an Urban Salt Marsh Restoration." In *Restoration of an Urban Salt Marsh: An Interdisciplinary Approach*, ed. D. G. Casagrande, 41–61. New Haven, CT: Yale School of Forestry and Environmental Studies Bulletin 100.

United States Army Corps of Engineers. 2004. "Louisiana Coastal Area (LCA), Louisiana. Ecosystem Restoration Study." New Orleans, LA.

United States Census Bureau. 2011. "Selected Social Characteristics in the United States. American Community Survey." http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

———. 2012. "The 2012 Statistical Abstract: The National Data Book. 481-Individual Income Tax Returns Filed–Examination Coverage. http://www.census.gov/compendia/statab/cats/federal_govt_finances_employment/federal_individual_income_tax_returns.html.

Vossler, C. A., M. Doyon, and D. Rondeau. 2012. "Truth in Consequentiality: Theory and Field Evidence on Discrete Choice Experiments." *American Economic Journal: Microeconomics* 4:145–71.

Vossler, C .A., and M. F. Evans. 2009. "Bridging the Gap between the Field and the Lab: Environmental Goods, Policy Maker Input, and Consequentiality." *Journal of Environmental Economics & Management* 58:338–45.

Wallmo, K., and S. Edwards. 2008. "Estimating Non-market Values of Marine Protected Areas: A Latent Class Modeling Approach." *Marine Resource Economics* 23:301–23.

Whitehead, J. C., and G. C. Blomquist. 1991. "Measuring Contingent Values for Wetlands: Effects of Information about Related Environmental Goods." *Water Resources Research* 27:2523–31.

Woodward, R. T., and Y.-S. Wui. 2001. "The Economic Value of Wetland Services: A Meta-analysis." *Ecological Economics* 37:257–70.