# Estimating the Willingness to Pay to Preserve Waterfront Open Spaces using Contingent Valuation

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**Abstract**

Waterfront open spaces provide environmental benefits, recreational opportunities, and prospects for water-dependent economic activities. However, with growing populations and associated urbanization, waterfronts and other open spaces often compete with roads, shopping centers, industrial development, and residential zones. Growth presents important challenges for elected officials, planners, and natural resource managers because, in addition to many benefits, urban development can increase stress on the landscape and compromise environmental quality and community resilience. This study employed a mail survey and contingent valuation method (CVM) to estimate residents' willingness to pay (WTP) to preserve open space in coastal cities in Alabama and Mississippi. Four different interval-censored regression models were constructed to estimate WTP to support open space preservation. Approximately 60% of respondents voted in favor of the proposal, which suggested the majority of residents valued open space preservation. Results indicated that coastal residents were willing to make a one-time payment of $80.52 to $162.14 per household. Respondents' membership in a conservation organization and income had a positive relationship with WTP, whereas age and residence duration were negatively associated. Findings provide evidence of positive open space value to local communities and can help policy makers and natural resource managers make better-informed decisions regarding the balance between open space preservation and urban development.

Keywords: Gulf of Mexico, interval censored model, mail survey, nonmarket valuation

Highlights

- A majority of residents were willing to pay for open space preservation.
- WTP was positively related with conservation group membership and household income.
- WTP had a negative relationship with respondents' age and residency duration.
- WTP for open space preservation ranged from $80.52 to $162.14 per household.
- A total monetary value of open space preservation was $10.84 million.

## 1.1 Introduction

Open spaces are socially-valued public and private areas with water permeable surfaces, located within or adjacent to populated places, and mostly devoid of built structures (McConell and Walls 2005; USDA Forest Service 2007). Such areas are partially or completely covered with trees, grass, water, and other vegetation and are often categorized as public parks (state and national parks), playgrounds (football, soccer, and baseball fields, and golf courses), wetlands, cemeteries, beaches, forested land, agricultural land, pastures, and shrub land (Bolitzer & Netusil, 2000; Klaiber & Phaneuf, 2010). Open space that represents terrestrial ground cover is often referred to as green space, whereas aquatic areas can be referred to as blue space, while open space adjacent to water bodies is waterfront open space (Taylor & Hochuli, 2017; Wentworth, 2017). In addition, working waterfronts, lands used for small water dependent activities such as recreational boat harbors, marinas, aquaculture, and fishing docks, may include some undeveloped waterfront open space (NWWN 2016). Open space provides a variety of benefits[1] including visual aesthetics, wildlife habitat, recreational opportunities, urban heat island reduction, air quality improvement, storm-water runoff control, energy use reduction, and a potential increase in real estate value (Brander & Koetse, 2011; Dwyer, McPherson, Schroeder, & Rowntree, 1992; Nowak, Hoehn III, Crane, Stevens, & Walton, 2007). In addition, open space provides health and sociocultural benefits (Campo, 2002; Shabman & Bertelson, 1979; Zhai & Suzuki, 2009). Open space benefits are a vital part of residents' everyday lives, and the value of open space to a high quality of life is increasingly recognized (Woolley and Rose 2004).

In particular, benefits from waterfront open space are critical to coastal communities and people who visit these places. However, with growing populations and urbanization, open space

[1] We acknowledge that some open spaces provide disservices, such as unmaintained abandoned lots.

50 can be threatened by urban development, such as roads, buildings, aeronautical flyways,
51 pollution, and other repercussions of growing cities (McDonald, Forman, & Kareiva, 2010; Wu,
52 Ye, Qi, & Zhang, 2013). Population statistics underscore the relevance of urban expansion in
53 natural resource management considerations. More than half (54.4%) of the total U.S. population
54 lived in rural areas in 1910, which decreased to less than a quarter (19.3%) in 2010, suggesting a
55 vast shift of population from rural to urban areas in the past century (U.S. Census Bureau 2016).
56 To accommodate the increase in urban population, urban land is projected to increase from
57 3.10% in 2000 to 8.10% in 2050 (Nowak et al., 2010). In particular, coastal regions have
58 experienced substantial population gains. For example, the population of coastal counties in the
59 Gulf of Mexico has increased by 150% from 1960 to 2008 (U.S. Census Bureau 2010).
60 Population growth often results in land conversion, fragmentation, and parcelization that
61 increases the potential for converting natural land to commercial and residential uses (Harper &
62 Crow, 2006). The rate of land conversion, due to anthropogenic activities, to developed land uses
63 is particularly high in coastal areas. Nationwide, the population in coastal counties increased by
64 43% during 1960-1990, faster than the national average (Ehrenfeld, 2000). Underscoring this,
65 256,100 acres of wetlands were lost in the Gulf of Mexico and 40% of this loss was attributed to
66 urban development between 1996 and 2006 (NOAA, 2010). Thus, the changing landscape due to
67 population growth and urbanization will have major impacts on environmental quality in urban
68 and urbanizing areas. Rapid growth presents challenges for elected officials, planners, and
69 natural resource managers in balancing economic growth and maintaining environmental quality.
70 With increasing urbanization, the preservation and management of open spaces has become an
71 important policy issue (Geoghegan, 2002).

Open space benefits are considered public goods (i.e., non-rival and non-exclusive) and are often characterized by inefficient market allocation (Geoghegan, 2002; Wolch, Wilson, & Fehrenbach, 2005). Fausold and Lilieholm (1999) categorized open space values as direct benefits from market and nonmarket goods and indirect benefits that positively impact local communities and economies. Benefits and services of open space that are traded in markets, such as timber and crops, can easily be valued monetarily (Mcconnell & Walls, 2005). However, environmental benefits that are not directly traded in markets are difficult to quantify in monetary terms (Brander & Koetse, 2011; More, Stevens, & Allen, 1988). Lack of a monetary value associated with environmental benefits makes it difficult to demonstrate their importance and, as a result, these services are often neglected in decision-making processes (Boyer and Polasky 2004; Sander and Polasky 2009; Fan and Yang 2010). Therefore, it is helpful to quantify a monetary value of nonmarket benefits of open space, which enables comparison of open space value with other land-use alternatives, assist in decisions pertaining to sufficient provision and conservation of open space benefits, and provide guidance for future land-use decisions.

Monetary valuation helps financial experts, city planners, and policy makers carry out benefit-cost analyses to guide informed environmental investment decisions and help gain public input into conservation decisions (Lambert 2003). In addition, a monetary value that society places on ecosystem services indicates the extent to which such services are prioritized which, in turn, informs decision makers regarding proposed conservation activities (Campbell & Brown, 2012). Using proper valuation techniques, decision makers can demonstrate environmental benefits per dollar spent and determine trade-offs between various land-development alternatives. For example, city planners and real estate developers can account for trade-offs between open space preservation and development when they have information on how the

95 public values open space areas (Anderson & West, 2006). Thus, there are practical applications
96 for quantitative and monetary assessments of the demand for open space preservation.
97 Economists have used a variety of techniques to quantify monetary values of open space.
98 There are two broad methodological approaches in quantifying monetary values of nonmarket
99 amenities: stated preference and revealed preference methods. The contingent valuation method
100 (CVM) is commonly used as a stated preference approach involving the elicitation of economic
101 value through the use of a hypothetical scenario posed to respondents (Cummings, Harrison, &
102 Rutström, 1995). In CVM, respondents are typically asked how much they are willing to pay
103 (WTP) or accept in compensation (WTA) for some change in quality or availability of
104 environmental goods and services (Hanley, MacMillan, Patterson, & Wright, 2003; Mitchell &
105 Carson, 1989). WTP represents the maximum amount of money an individual is willing to pay to
106 preserve an environmental amenity, such as waterfront open space, or improvement in the
107 quality of open space (Carson, 2012). Conversely, WTA is the minimum amount of money that
108 an individual is willing to accept as a compensation when the individual is made worse off due to
109 a decrease in environmental quality (Alberini, Boyle, & Welsh, 2003). Both WTP and WTA are
110 based in Hicksian welfare constructs and can be effectively used to quantify the monetary value
111 of environmental amenities, such as those associated with open space (Balisteri et al. 2001 and
112 Kolstad 2011).
113 Many previous studies used the WTP approach to assess monetary value of open space
114 benefits. For example, Breffle et al. (1998) used CVM to estimate the value of 5.5 acres of
115 undeveloped land. In-person interviews were conducted and the respondents were asked how
116 much they were willing to pay to keep the land undeveloped forever. The authors estimated a
117 mean WTP of $234.00 per household to preserve the land. The authors found that the amount of

118 WTP was greater than the cost of land when the distance was extrapolated to include one mile of
119 neighborhood property. Lorenzo et al. (2000) estimated WTP to preserve urban forest in
120 Mandeville, Louisiana. Results showed that more than 80% of respondents believed that
121 protection and preservation of urban trees was an important function of the city and they were
122 willing to pay at least $6.00 per person per year for their protection. Similarly, Loomis et al.
123 (2000) estimated the total economic value of restoring ecosystem services such as dilution of
124 wastewater, natural purification of water, erosion control, habitat for fish and wildlife, and
125 recreation. Authors estimated that households were, on average, willing to pay $21.00 per month
126 for the additional ecosystem services. The authors concluded that generalizing the benefit of
127 ecosystem services, as estimated by household willingness to pay, would exceed the water
128 leasing cost of $1.13 million and Conservation Reserve Program farmland easement cost of
129 $12.30 million.
130 In another study, Cho et al. (2005) used tobit and heckit regression models to quantify a
131 monetary value of a hypothetical land conservation easement in Macon County, North Carolina.
132 Their WTP estimates to participate in the program via a property tax increase ranged from
133 $10.97 to $21.79 per household. Jim and Chen (2006) conducted a similar study to estimate the
134 monetary value of recreational amenity use of urban green space via face-to face interview
135 surveys. The authors found that 96.60% of respondents were willing to pay to use urban green
136 space for leisure activities. The mean WTP was estimated to be $2.11 per person per month,
137 which was higher than the entrance fee. The monetary value of green space was $66.22 million
138 per year when aggregated, which was six times larger than the annual expenditure made on urban
139 green space in the study area. Another study by Majumdar et al. (2011) estimated monetary
140 values of Savannah's (Georgia) urban forest. Estimated median WTP was $2.10 as a fee per visit

141 to access any urban forest resources, and based on this value, the annual value of urban forest
142 was estimated to be $11.50 million. Thus, numerous studies have used CVM and estimated
143 monetary value of nonmarket benefits and services of open space to illustrate importance of
144 these benefits to human welfare and facilitate more informed natural resource conservation
145 decisions.

146 This study used the WTP approach to estimate monetary values associated with urban
147 open spaces in the Alabama and Mississippi Gulf Coast. The study included urban areas
148 characterized by intense population pressure, loss of open space and associated environmental
149 benefits, and land fragmentation. In this study, all types of open space were considered; however,
150 waterfront open space was of particular interest in this study. The study focused on ecosystem
151 services, including coastal habitat, water quality, and small-scale waterfront businesses. This
152 study determined coastal residents' attitudes towards waterfront open space and commercial and
153 residential growth. Besides its focus on urban areas of the Gulf Coast, this study is unique in its
154 use of multi-model comparison of WTP estimates to identify an appropriate model for deriving
155 the highest degree of precision available from WTP estimates. As well, the study examined the
156 association of sociodemographic characteristics with WTP to preserve waterfront open space.
157 Thus, this study provides estimates of the monetary value coastal residents placed on open space
158 and identifies their attitudes towards open space preservation. This information can be used in
159 future urban development decisions to quantify monetary tradeoffs associated with open space
160 preservation and facilitate conservation initiatives that balance the need for open space
161 preservation and residential and commercial development. The findings can also be applied to
162 other urban areas where preservation of open space is needed.

## 1.2 Material and methods

### 1.2.1 Study area

The study was conducted in four coastal cities of Mississippi and Alabama, located in the southern United States: Gulfport, Ocean Springs, Mobile, and Daphne (Figure 1). Over 19% of the study area is water bodies (U.S. Census Bureau, 2012a and 2012b). From 1990 to 2010, the study area population increased by 14.70% and housing units increased by 23.57% (U.S. Census Bureau, 2012a and 2012b). Between 2000 and 2010, housing growth slowed to 6.37% compared to the previous decade of 16.17% and might be due to impacts from Hurricane Katrina (2005) and the 2007-2009 economic recession.

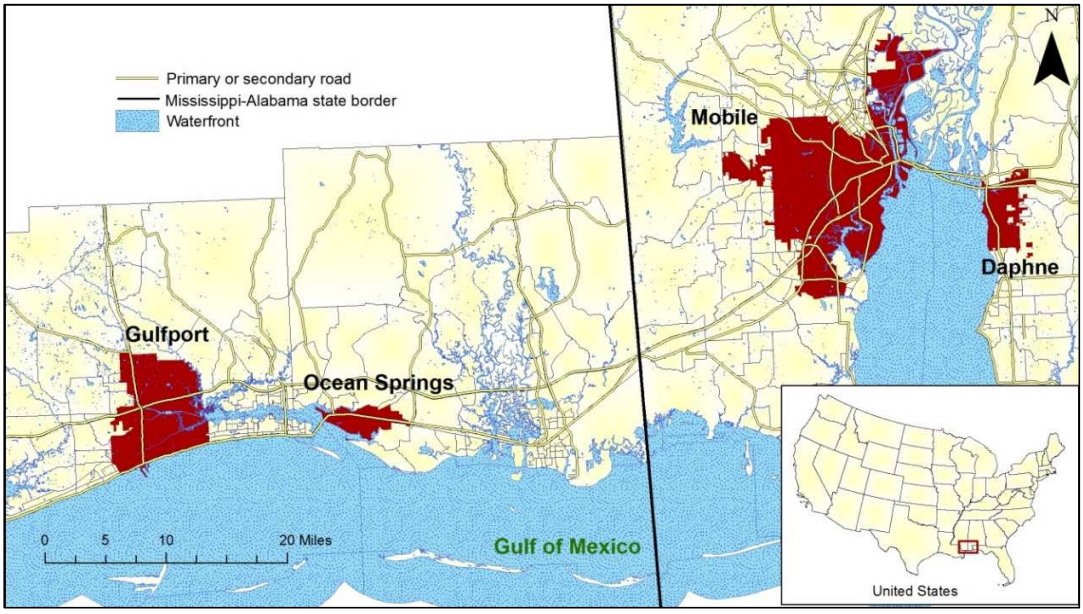


Figure 1. Study area location in the Gulf of Mexico.

### 1.2.2 Data collection

Data for this study were collected via a mail survey[2] sent to 3,999 households of the four sites in 2015 selected using a simple random sampling procedure. Each site received a number of

[2] The original questionnaire is available from the corresponding author upon request.

surveys proportional to its population: Gulfport (23%), Ocean Springs (6%), Mobile (63%), and Daphne (8%). Sample size of 3,999 was selected to ensure that 384 completed questionnaires would be returned assuming a 95% confidence level, 5% of margin of error, and an expected low response rate of 10%, given it assessed environmental attitudes (Dillman, Smyth, & Christian, 2009). The mail survey was designed using the Tailored Design Method (Dillman et al., 2009) in which residents were contacted four times via: (1) an introductory letter describing the research project; (2) a letter with a survey questionnaire; (3) a thank you/reminder postcard; and (4) a follow-up questionnaire. The mail survey questionnaire also included a web-link to an online version of the questionnaire for participants who preferred to participate in the survey electronically. To improve and calibrate the questionnaire, a pilot survey was conducted in person before dispatching the questionnaire to the sample. The questionnaire was composed of six sections that focused on respondents' attitudes towards commercial and residential growth, economic development, and open space; willingness to pay to support open space preservation associated with waterfront areas; and participant sociodemographic characteristics. The questionnaire included definitions of a working waterfront, as defined by the National Working Waterfront Network (NWWN), and open space. Working waterfront was defined as waterfront lands, infrastructure, and waterways used for small-scale water-dependent activities, whereas open space was defined as socially valued public and private landscape with water permeable ground cover. Reflecting NWWN, the survey assumed that open space and working waterfronts were compatible.

A contingent valuation section was included in the questionnaire to determine respondents' WTP for open space preservation associated with waterfront areas. Respondents were asked to consider a hypothetical scenario in which the local government proposed a

dedicated fund to purchase land and create areas that promote and protect coastal habitat and water quality while also promoting small-scale waterfront business (consistent with the presented definition of a working waterfront). The decision to fund the open space-working waterfront proposal would be made through a ballot voting initiative. It was assumed that if more than 50% of the voters were in favor of the ballot initiative, the referendum would be binding and each household would be required to make a one-time payment via their water bill. The land purchase would be completed within the next five years and public access to these properties would be available starting in 2020. The typical payment vehicle used in CVM studies are levies on income taxes, water or land rates, increased park entrance fees, and increased sales taxes (Morrison, Blamey, & Bennett, 2000). Loomis and DuVair (1993), Cameron and Quiggin (1994), and Kim et al. (2012) used income tax, whereas Loomis et al. (2000) used a water bill as the payment vehicle. The selection of a payment vehicle can be challenging as it should be realistic, appropriate, and should remind respondents about their budget constraints so they do not overstate their true WTP (Venkatachalam, 2004). An income tax vehicle may suffer from a problem of respondents' resistance to higher taxes (Boyle, 2003). For this study, a water bill was selected as an appropriate payment vehicle given the nature of the project. After a description of the hypothetical scenario, respondents were presented with referendum question. The name of the respondent's community was included with the CV scenario and each respondent was asked to answer the referendum question referring to her or his community.

There were two referendum questions presented in the survey. The first question was designed as a single referendum (SR) question. Respondents were given three possible options to select as a response to the question: 'For the proposal', 'Against the proposal', and 'Unsure/don't know'. The SR question was constructed as follows:

222 *"If there was a ballot proposal for a one-time payment of $__ added to your water bill to*
223 *increase open space, would you vote for or against the proposal?"*
224 where a blank space following a $ sign was filled with one of 11 randomly-assigned payment
225 amounts (bids): $1, $10, $20, $30, $40, $50, $60, $70, $80, $90, and $100. Payment amounts
226 were determined based on the pilot survey and the literature.
227 A follow-up question was constructed as a double referendum (DR) question and
228 included choices for additional payments. The advantage of including a follow-up question in a
229 survey is that it can help produce more efficient estimates than using the SR question alone
230 (Alberini et al., 2003; Hanemann, Loomis, & Kanninen, 1991). The follow-up question was
231 constructed as:
232 *"How much more would you be willing to pay as a one-time payment in addition to the amount*
233 *specified in the question__?"*
234 where a blank space represented SR question number in the questionnaire. The respondents were
235 given five possible options to select as a response to the DR question: 'None', 'About half', 'The
236 same', 'About twice the amount', and 'More than twice the amount'. The follow-up debriefing
237 question was posed to those respondents' who voted against the initial bid question.

238 **1.2.3 Non-response bias test**

239 Survey data may suffer from a non-response bias if non-respondents significantly differ
240 from respondents in terms of observable characteristics that influence WTP leading to
241 unrepresentative responses (Whitehead, Groothuis, & Blomquist, 1993). Drawing conclusions
242 based on unrepresentative data might generate biased results. To determine if the survey
243 responses suffered from a non-response bias, a non-response bias test was implemented. If a non-
244 response bias is not present, then generalizing the response data to the general survey population

245 is valid (Armstrong & Overton, 1977). In order to test for existence of non-response bias, a
246 condensed version of the questionnaire with key questions, such as those related to
247 sociodemographic characteristics and attitudes towards open space, was designed and sent after
248 the completion of the original mailing to a remaining 2,680 non-respondents. Lambert and
249 Harrington (1990) also used this approach in testing for a non-response bias. A non-response
250 bias test was conducted by comparing responses from a non-response mail survey with the
251 responses obtained from the original mail survey using a t-test for continuous variables and chi-
252 square test for categorical variables.

253 **1.2.4 Econometric model**

254 A random willingness to pay model, developed by Cameron and James (1987) as an
255 alternative to the random utility model, was followed with the dependent variable representing
256 unobserved WTP as a continuous random variable $(Y_i)$ and independent variables as a vector of
257 the observed variables $(X_i)$:

258 $$Y_i = X_i^{'}\beta + \varepsilon_i \quad (1)$$

259 where $\beta$'s are the parameters to be estimated, and $\varepsilon_i$ $(\varepsilon \sim N(0,\sigma^2 I))$ is the error term which
260 represents variables not included in the model but which cause variation in the dependent
261 variable.

262 From the responses obtained through the CV question, inference about whether the
263 respondent's WTP was above or below the offered payment amount ($t_i$) was made. The
264 respondent voted 'For the proposal' if her/his WTP was higher or equal to the required payment
265 amount and voted 'Against the proposal' if her/his WTP was lower than the required payment
266 amount.

The SR dichotomous choice question proposed by Bishop and Heberlein (1979) is the simplest and most widely used method for eliciting respondents' WTP in CVM studies (Kim et al., 2012). The SR provides one of two bounds on WTP. If the respondent voted 'For the proposal' at the given payment, $t_i$, her/his WTP was assumed to be greater than or equal to a payment, $t_i$ and was regarded as her/his lower bound. Similarly, if the respondent voted 'Against the proposal' at the given payment, $t_i$, her/his WTP was assumed to be less than payment, $t_i$ and was regarded as her/his upper bound:

$t_i \leq WTP;$ if respondent voted 'For the proposal'

$t_i > WTP;$ if respondent voted 'Against the proposal'

While the SR is a relatively easy question for respondents to answer, it is often regarded as a less efficient approach because it requires a large sample to attain a specified level of precision (Hanemann et al., 1991). In response to this limitation, Hanemann et al. (1991) developed a double-referendum (DR) model to improve the efficiency. In the DR model, respondents were asked a second question immediately after answering the first SR question. The payment included in the second question was higher for respondents who answered 'For the proposal' to the first question. This information lowers the variance of the estimates of a mean WTP (Haab & McConnell, 2002). The DR model increases efficiency over SR model by constraining the part of distribution where respondents report false WTP amounts (Haab & McConnell, 2002). The model produced both WTP's lower and upper bounds for each respondent which can be written as:

$t_1 \leq WTP \leq t_2;$ for 'For the proposal'-'Against the proposal' responses

$WTP \geq t_2;$ for 'For the proposal'-'For the proposal' responses

$WTP < t_1;$ for 'Against the proposal'

where $t_1$ and $t_2$ are payment levels included in the initial SR and a follow-up DR questions, respectively. The additional information collected from the follow-up DR question was directly incorporated to update the bounds on WTP in DR model.

DR has been criticized by many researchers because of numerous biases associated with it (Trudy Ann Cameron & Quiggin, 1994; Haab & McConnell, 2002). For instanceThese biases include starting-point bias, in which a response to a follow-up question is influenced by the bid level in the first question (Mitchell and Carson 1993; Herriges and Shogren 1996; Flacjaire and Hollard 2006); a shifting-effect bias, in which a respondent interprets a change in payment as a signal of altered quality of the project (Carson et al. 1992; Alberni et al. 1997; Watson and Ryan 2007); and a strategic bias, in which respondents may react to the new bid level as a signal that they can bargain over the price (Cooper et al. 2002; Carson and Groves 2007).

Designating WTP bound as a dependent variable resulted in interval data: a lower and upper bound. The survey in this study included a follow-up question only for the respondents who wished to make an additional payment to increase open space preservation associated with waterfronts areas. Thus, responses 'For the proposal' in the initial question and 'Against the proposal' in the follow-up question resulted in point data (both lower and upper bound on WTP being the same). In a similar fashion, bounds on WTP were developed as interval, left-censored, and right censored. To analyze these data and to estimate marginal WTP to support open space preservation associated with waterfront areas, an interval censored model was used (Hanemann et al., 1991). An interval censored regression model is useful when a researcher knows the ordered categories into which observations fall, but is unaware of each observation's exact value (IDRE, 2017).

Table 1 illustrates the type of data used in the econometric model to estimate WTP. For example, if the respondents voted 'For the proposal' at a given payment ($t_1$) in the initial question and 'Against the proposal' in the follow-up question (she/he was not willing to pay any additional amount), then it was regarded as a point data ($t_1$, $t_1$). If the respondent voted 'For the proposal' at a given payment ($t_1$) in the initial question and then was willing to pay an additional amount in the second question ranging from about half to about twice the additional amount ($t_2$), then these two observations were combined and resulted in interval data ($t_1$, $t_2$). If the respondents voted 'Against the proposal' in the initial question then it was left censored data ($-\infty$, $t_1$) because in this case her/his WTP was less or equal to a payment ($t_2$) and was considered as her/his upper bound. Similarly, if the respondent was willing to pay more than twice the amount in the second question, then it was right censored data ($t_2$, $\infty$) because, her/his WTP was greater than or equal to payment ($t_2$). Thus, in a case of left-censored data the lower bound was a negative infinity, whereas for the right censored data the upper bound was a positive infinity. For point data, lower and upper payment amounts were considered equal.

Table 1. Data types used in the interval-censored model to estimate marginal WTP to increase open space preservation in coastal cities of Alabama and Mississippi.

| Type of data | | Lower bound | Upper bound |
|---|---|---|---|
| Point data | A=[$t_1$,$t_1$] | $t_1$ | $t_1$ |
| Interval data | A=[$t_1$,$t_2$] | $t_1$ | $t_2$ |
| Left-censored data | A=[$-\infty$,$t_1$] | NA | $t_1$ |
| Right-censored data | A=[$t_2$,$+\infty$ ] | $t_2$ | NA |

The contribution of likelihood function of an $i^{th}$ individual respondent whose value of WTP was somewhere in the interval ($t_{1i}$ as lower bound and $t_{2i}$ as upper bound) is represented by $\Pr(t_{1i} \leq Y_i \leq t_{2i})$. When no information was gained on the bound of WTP from the CV question, it resulted in being either left-censored for an individual with 'Against the proposal'

vote or right-censored with 'For the proposal' vote, and the likelihood function was represented by $\Pr(Y_i < t_{Li})$ and $\Pr(Y_i \geq t_{Ri})$, respectively. For the normally distributed error term, $\varepsilon \sim N(0, \sigma^2 I)$, the log-likelihood function is given by:

$$logL = \sum_{i \in L} log\phi\left(\frac{t_{Li} - x_i'\beta}{\sigma}\right) + \sum_{i \in R} log\{1 - \phi\left(\frac{t_{Ri} - x_i'\beta}{\sigma}\right)\} + \sum_{i \in I} log\{\phi\left(\frac{t_{2i} - x_i'\beta}{\sigma}\right) - \phi\left(\frac{t_{1i} - x_i'\beta}{\sigma}\right)\} \quad (2)$$

where ϕ(.) is the standard cumulative normal distribution and observations $i \in L$, $i \in R$, and $i \in I$ are left-censored, right-censored, and interval, respectively. This study estimated the model using the maximum likelihood estimator. Maximizing the likelihood function produced estimates of the function's parameters (Haab & McConnell, 2002).

Having an unbounded model may yield either negative or excessively large WTP and thus a reasonable bound should be placed to estimate WTP (Haab & McConnell, 2002). Hanemann and Kanninen (2001) argued that willingness to pay should be bounded at the upper level by income and lower level by zero (zero-income bound). WTP may be negative only when the minimum expenditure necessary to achieve utility at the new CV scenario exceeds the individual's income (Haab & McConnell, 2002). As respondents' WTP depends on income ($y_i$) and the vector ($\overline{z_j}$), the restriction on WTP can be defined as:

$$0 \leq WTP_j \leq y_j \quad (3)$$

The payment range was thus updated by replacing negative infinity with zero and positive infinity with the respondents' income following Kim et al. (2012). There is a lack of consensus in the literature regarding bounded and unbounded approaches (Kim et al., 2012). Therefore, this study estimated median WTP used both approaches, bounded and unbounded, and developed four models: (1) a single unbounded interval censored model (using a SR question only with left-censored as negative infinity and right-censored as positive infinity); (2) double unbounded interval censored model (using a DR question in addition to a SR question with left-

censored as negative infinity and right-censored as positive infinity), (3) single bounded interval censored model (using a SR question only with left-censored as zero and right-censored as respondent's income); and (4) a double bounded interval censored model (using the DR question in addition to the SR question with left-censored as zero and right-censored as respondent's income).

Median WTPs and their confidence intervals were estimated following the Krinsky and Robb (1986) procedure discussed in Haab and McConnell (2002). The Krinsky and Robb procedure in computing welfare estimates has been recommended by many studies (e.g. Park et al. 1991; Carlsson et al. 2003; Yoo and Kwak 2009). The procedure relies on the asymptotic properties of maximum likelihood parameter estimates and simulates asymptotic distribution of derived WTPs (Haab & McConnell, 2002). The first step in the procedure was to estimate the interval censored model and to obtain parameter estimates $\hat{\beta}$ and variance-covariance matrix $\hat{V}(\hat{\beta})$. The second step was to obtain Cholesky decomposition matrix, *C,* such that $CC' = \hat{V}(\hat{\beta})$. As a next step, a single *K*-vector was drawn from the estimated asymptotic distribution of the parameter $\beta_d$ as:

$$\beta_d = \hat{\beta} + C' X_K \quad (4)$$

where $X_K$ is the random vector drawn from the standard normal distribution. This procedure was repeated 10,000 times for each model to produce a simulation of the full distribution parameter $\hat{\beta}$ distributed $N\left(\hat{\beta}, \hat{V}\left(\hat{\beta}\right)\right)$ under ideal asymptotic conditions. Finally, WTP was calculated based on a new parameter vector, $\beta_d$ (Equation 4). This process resulted in 10,000 simulated WTP estimates, which were then sorted in ascending order and empirical statistics were calculated such as mean, variance, and a 95% confidence interval.

### 1.2.5 Variable description

Table 2 provides descriptions of variables used in estimating median WTP and their mean values. Respondents who were unsure about their vote and those with missing values in the independent variables were omitted in the econometric model. Three sets of independent variables were used in estimating WTP. The first set included variables representing respondent's attitudes towards open space. This category included four variables. GROUP indicated if a respondent belonged to any group promoting environmental or conservation goals. This variable was selected to determine if association with environmental organizations or goals affected their decision to support preservation of waterfront open space (Hanley et al., 1998; Loomis et al., 2000). FUTDEV represented respondent attitudes towards whether future development should preserve the coastal character in the community. In creating diverse urban landscapes, both green space and urban development are important. Thus, this variable captured not only respondent attitudes towards open space preservation, but also indicated an acceptable level of future growth in the community (Bridger, 1996; Jim, 2004). OPENUSE measured the frequency of the respondent's use of open space. It was assumed that a frequent visitation is induced by quality and accessibility to open space (Jim & Chen, 2006). Thus, frequency of open space was used in the model to capture importance of open space to respondents. GOVTRESP referred to whether the respondent felt that the local government had a responsibility to the public to provide usable public open space. This variable illustrated importance of government in managing open space and allowed for examining relations between social and political perception for open space preservation (Dietz, Stern, & Rycroft, 1989).

The second set of variables included in the model represented the important features of a coastal community character. This category focused on aspects describing the coastal

401 socioeconomic context necessary to formulate integrated planning for sustainable use of open
402 spaces (Rosenthal et al., 2012). This category included variables representing environmental
403 attributes (ENVINDEX), gaming and tourism (GTINDEX), and shipping and seafood industry
404 (SSINDEX) indexes. ENVINDEX was measured with different elements of a coastal character
405 such as close to nature, good place for family, and favorable climate. This variable was included
406 in the model because it illustrated the importance of aesthetic, visual, and environmental
407 dimensions of open space to respondents (McConnell & Walls, 2005). GTINDEX was measured
408 with two separate elements including gaming and tourism because tourism and gaming are
409 regarded as one of the key income generators in the study area (Adams, Hernandez, & Cato,
410 2004). This variable was included to assess the impact of tourism and gaming on open space
411 preservation. SSINDEX was also measured based on two separate elements including the
412 shipping industry and the seafood industry. Waterfront open space in the Gulf Coast has been
413 commercially used by shipping and seafood industry (NOAA 2016; NOAA 2018). Thus,
414 SSINDEX variable was incorporated to determine if decisions related open space preservation
415 were impacted by importance of these two industries to local communities. All of these elements
416 were initially measured as a mean grand score based on individual scores for each coastal
417 element using a five-point Likert scale: 1 – strongly disagree, 2 – disagree, 3 – neither agree nor
418 disagree, 4 – agree, and 5 – strongly agree. Then, a grand score was converted to a binary
419 variable with values above to the grand mean Likert score coded as 1 (agree) and below mean as
420 0 (disagree).

421 The third set of variables included respondents' sociodemographic characteristics.
422 Contingent valuation surveys usually include information related to respondent socio-
423 demographic characteristics to determine if they influenced WTP estimates (Majumdar et al.,

2011; Portney, 1994). This study included socio-demographic variables selected based on previous studies. For example, duration of residence (RESD) (Johnston, Swallow, Tyrrell, & Bauer, 2003); age (AGE), gender (GENDER), education (EDU), and household income (INC), race (RACE) (Brummett, Nayga, & Wu, 2007; Majumdar et al., 2011) were included in previous WTP studies. A variable representing renting or owning status of their dwelling space (RENT) was included because respondents who owned dwelling pay their water bill whereas some of the renters might not pay for water bill. Thus, this variable was used to quantify the effect of renting versus owning the property on WTP because the payment vehicle used in contingent valuation scenario was a water bill. An interaction term between respondents' age and residency (AR) was also included in the model to estimate how WTP was affected by older age residents who lived in the community for a longer period of time. Variables were originally recorded using a five-point Likert scale (FUTDEV, ENVINDEX, GTINDEX, and SSINDEX), continuous (AGE and INC), dichotomous (GROUP, GOVTRESP, GENDER, and RENT), nominal (EDU and RACE), and ordinal (OPENUSE and RESD) responses. For analysis purposes, all variables were transformed into binary variables based on the mean Likert score for each variable where individually reported Likert scores above the mean Likert score were recoded as 1 and 0 if they were below the mean score.

Table 2. Description of variables used in estimating WTP to increase open space preservation associated with waterfront areas in coastal cities of Alabama and Mississippi (N=245).

| Variables | Description | Mean |
|---|---|---|
| *Respondents' attitudes towards open space* | | |
| GROUP | Membership in a group promoting environmental or conservation goals: 1 if a respondent belonged to any group promoting environmental or conservation goals, 0 if no. | 0.23 |
| FUTDEV[a,b] | Importance of future development to preserve the coastal character: 1 if important and 0 otherwise. | 0.97 |
| OPENUSE[a,c] | Frequency of using local open space: 1 if used frequently and 0 otherwise. | 0.82 |
| GOVTRESP | Responsibility of local government to provide usable public open space: 1 if respondent thought that it was a responsibility of local government to provide usable public open space , 0 if no. | 0.96 |
| *Important features of coastal character*[d] | | |
| ENVINDEX | Importance to community's coastal character (close to nature, good place for family, favorable climate): 1 if respondent agreed and 0 otherwise. | 0.79 |
| GTINDEX | Importance of gaming and tourism industry (other than gaming) to community's coastal character: 1 if respondent agreed and 0 otherwise. | 0.37 |
| SSINDEX | Importance of shipping and seafood industries to community's coastal character: 1 if respondent agreed and 0 otherwise. | 0.71 |
| *Respondents' sociodemographic characteristics* | | |
| RESD[a] | Number of years a respondent has lived in the community: 1 if 15 years or more, 0 if less than 15 years. | 0.71 |
| AGE[a] | Respondent's age: 1 if 65 year or older, 0 if less than 65 years. | 0.35 |
| AR | Interaction effect of age and number of years a respondent has lived in the community. | 0.27 |
| GENDER | Gender: 1 if male, 0 if female | 0.54 |
| EDU[a] | Highest education level: 1 if respondent received bachelor's degree or higher, 0 if less. | 0.62 |
| INC[a] | Household income before taxes in 2015 U.S. dollars: 1 if income was $65,000 or larger, 0 if less than $65,000. | 0.571 |
| RACE[a] | Respondent's: 1 if white/Caucasian, 0 if otherwise. | 0.812 |
| RENT | Status of dwelling ownership: 1 if rented and 0 if owned. | 0.131 |

[a] Variables were recoded into a binary variable based on mean of each variable where values greater than the mean were coded as 1 and values smaller than mean were coded as 0.

[b] Initially measured as 1 – major, 2 – moderate, 3 – minor, 4 – slight, and 5 – not at all.

[c] Initially measured as 1 more than one time per month, 2 – less than one time per month, 3 – more than one time per year, 4 – just once per year, 5 – once in last couple of years, 6 – once in last five years, and 7 – never.

[d] Initially measured as a mean grand score based on individual scores for each coastal element measured on a five-point Likert scale: 1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, and 5 – strongly agree. Then, a grand score was converted to a binary variable with values above the grand mean coded as 1 (agree) and below the mean coded as 0 (disagree).

## 1.3 Results

Of 3,999 mailed questionnaires, 1,079 questionnaires were returned as undeliverable and 49 as refusals or with a respondent reported as deceased, resulting in a useable sample of 2,871. Respondents returned 438 questionnaires with valid responses resulting in an adjusted response rate of 15.26%. Response was lower than expected; however, a comparison of responses from the original mail survey and a separate follow-up non-response mailing indicated there was no non-response bias: age ($p$=0.531), race/ethnicity ($p$=0.304), gender ($p$=0.2051), education ($p$=0.826), rent/own your dwelling ($p$=0.536), income ($p$=0.191), working waterfronts considered as threatened ($p$=0.2036), and importance of working waterfronts to community's history and culture ($p$=0.3723). Thus, generalizing responses to the entire survey population was statistically valid.

### 1.3.1 Demographic overview

Summary statistics of all returned questionnaires indicated gender composition (male vs. female) of respondents was equal (48.33% vs. 48.80%), whereas 2.87% of respondents did not wish to reveal their gender. Average age of the respondents was 59 years old with 47.78% older than 65 years old and 20.44% younger than 45 years old. One third (30.36%) of respondents reported their total household income in 2015 dollars before taxes to be less than $45,000, whereas 51.28% had a household income greater than $65,000, which was above mean household income of $60,511 in Alabama and $54,906 in Mississippi for the year 2015 (U.S. Census Bureau 2015). More than half of respondents (56.97%) either had completed a Bachelor's degree or had a post-graduate degree, whereas 9.69% had a high school education. About three-fourths of the respondents (74.88%) were Caucasian followed by African American (17.77%), whereas each of the other ethnic groups such as Asian, Native American, and

Hispanic/Latino represented less than one percent. A total of 70.33% of respondents reported they had lived in their community for more than 15 years, whereas 21.77% had lived in their community for less than 10 years. Most respondents (84.74%) owned their dwelling, whereas 15.26% rented.

### 1.3.2 Attitudes towards open space and working waterfronts

Most respondents (96.93%) believed that it was important that future development preserves the coastal character of their community. More than half of respondents (57.21%) thought working waterfronts were very important for their community's history and identity, whereas 11.82% believed it was moderately important. The majority of respondents (71.29%) also believed that working waterfronts composed of small-scale businesses were threatened. More than 65% of respondents believed that commercial development, property taxes, storms, changing economy and offshore energy production were major threats to the existence of working waterfronts (Table 3). Most respondents believed coastal storms (88.86%) and a changing economy (81.95%) were the most threatening factors to the existence of working waterfronts, whereas residential growth had relatively less of an impact (46.24%). More than half of respondents (56.91%) regularly used (more than once per month) local open space for various purposes, whereas only 4.42% of respondents had never used open space. Most of respondents (94.39%) believed that local government had a responsibility to the public to provide usable public open space. One-fifth of respondents (19.43%) belonged to groups promoting environmental conservation (e.g., Ducks Unlimited, Sierra Club, forest landowner associations). In addition, nearly half of respondents (40.83%) believed that commercial development was a major growth issue in their community as opposed to residential development (28.12%), people relocating from other places (22.98%), and urban sprawl (22.49%).

500 Table 3. Factors threatening the existence of working waterfronts in the community based on a
501 2015 mail survey conducted in coastal cities of Alabama and Mississippi.

| Factors | Threat to working waterfront existence (%) | | | | | Mean Score | Median Score |
|---|---|---|---|---|---|---|---|
| | None (1) | Very Little (2) | Moderate (3) | High (4) | Very High (5) | | |
| Residential development | 15.32 | 38.44 | 31.50 | 9.25 | 5.49 | 2.51 | 2.40 |
| Commercial development | 8.93 | 20.75 | 37.18 | 24.78 | 8.36 | 3.03 | 3.05 |
| Property taxes | 8.99 | 21.45 | 31.88 | 20.87 | 16.81 | 3.15 | 3.11 |
| Coastal storms | 2.57 | 8.57 | 29.43 | 33.14 | 26.29 | 3.72 | 3.78 |
| Changing economy | 4.01 | 14.04 | 42.98 | 24.64 | 14.33 | 3.31 | 3.24 |
| Offshore energy production | 9.94 | 22.51 | 33.92 | 17.25 | 16.37 | 3.08 | 3.02 |

502

503 More than 80% of respondents agreed that being close to nature, the seafood industry,
504 good place for family, and favorable climate were the most important elements of their
505 community's coastal character (Table 4). Most respondents (74.49%) agreed tourism (other than
506 gaming) was an important element of coastal character, while 68.70% thought it was a shipping
507 industry, and 31.29% indicated the gaming industry was important. Factors such as close to
508 nature, good place for family, and a favorable climate had mean and median scores of more than
509 4.10 suggesting respondents were more inclined to the aesthetic aspects of open space.

510 Table 4. Importance of different coastal characteristics based on a 2015 mail survey conducted in
511 coastal cities of Alabama and Mississippi.

| Coastal elements | Importance of coastal elements (%) | | | | | Mean score | Median score |
|---|---|---|---|---|---|---|---|
| | Strongly disagree (1) | Disagree (2) | Neither agree nor disagree (3) | Agree (4) | Strongly agree (5) | | |
| Close to nature | 1.17 | 3.23 | 12.90 | 49.56 | 33.14 | 4.10 | 4.16 |
| Shipping industry | 2.03 | 7.83 | 21.45 | 48.12 | 20.58 | 3.77 | 3.89 |
| Seafood industry | 0.86 | 4.30 | 10.03 | 46.70 | 38.11 | 4.17 | 4.25 |
| Gaming | 22.51 | 15.79 | 30.41 | 20.18 | 11.11 | 2.82 | 2.88 |
| Tourism (other than gaming) | 1.45 | 5.22 | 18.84 | 48.99 | 25.51 | 3.92 | 4.00 |
| Good place for family | 0.57 | 1.44 | 10.92 | 51.44 | 35.63 | 4.20 | 4.22 |
| Favorable climate | 1.15 | 1.72 | 7.45 | 54.44 | 35.24 | 4.21 | 4.43 |

512

513 More than half of respondents (53.96%) agreed that waterfronts should be protected at
514 any cost, whereas only 20.05% disagreed (Table 5). About three-fourths of respondents (75.67%)
515 believed waterfronts should be protected using both public and private initiatives. Only few
516 respondents believed that waterfronts may be forced to disappear (18.77%) or were not worth
517 protecting (3.79%).

518

519 Table 5. Importance of protecting working waterfronts in the community based on a 2015 mail
520 survey conducted in coastal cities of Alabama and Mississippi.

| Opinions related to working waterfront protection | Agreement with waterfront protection (%) | | | | | Mean score | Median score |
|---|---|---|---|---|---|---|---|
| | Strongly disagree (1) | Disagree (2) | Neither agree nor disagree (3) | Agree (4) | Strongly Agree (5) | | |
| Should be protected at any cost | 3.22 | 16.83 | 25.99 | 36.39 | 17.57 | 3.48 | 3.61 |
| Should be protected only using private initiatives | 7.83 | 35.10 | 37.63 | 14.90 | 4.55 | 2.73 | 2.69 |
| Should be protected using public and private initiatives | 2.19 | 4.38 | 17.76 | 55.96 | 19.71 | 3.87 | 3.96 |
| May be forced to disappear | 20.81 | 33.25 | 27.16 | 14.47 | 4.31 | 2.48 | 2.38 |
| Are not worth protecting | 63.13 | 25.51 | 7.58 | 1.77 | 2.02 | 1.54 | 1.29 |

### 1.3.3 Willingness to pay to preserve waterfront open space

Of 438 returned surveys, 379 contained answers to the contingent valuation scenario question. More than half of respondents (58.58%) voted 'For the proposal' to purchase land for open space preservation associated with waterfront areas at any payment level, 21.37% voted 'Against the proposal', and the remainder (20.05%) were unsure (Table 6). The number of respondents voting 'For the proposal' was higher at lower payment levels. For example, at the payment level of $1, 82.86% of respondents voted for the proposal, whereas 11.43% against it. However, when the payment amount was increased to $100, 55.56% of respondents voted 'For the proposal' and 25.00% voted 'Against the proposal'. Although the number of respondents willing to support the proposal decreased with higher payment levels, the majority of respondents were still willing to make a one-time payment of $70 to $100 to increase open space preservation suggesting that percentage of respondents did not decrease at higher payment levels as expected.

Table 6. Respondents' willingness to support a ballot proposal to purchase land to increase open space at selected payment levels based on a 2015 mail survey conducted in coastal cities of Alabama and Mississippi.

| Payment amount ($) | Number of responses in each category | | | | | | Total responses in a category |
|---|---|---|---|---|---|---|---|
| | Yes votes | | No votes | | Unsure votes | | |
| | Frequency | % | Frequency | % | Frequency | % | |
| 1 | 29 | 82.86 | 4 | 11.43 | 2 | 5.71 | 35 |
| 10 | 28 | 70.00 | 9 | 22.50 | 3 | 7.50 | 40 |
| 20 | 22 | 70.97 | 5 | 16.13 | 4 | 12.90 | 31 |
| 30 | 15 | 42.86 | 7 | 20.00 | 13 | 37.14 | 35 |
| 40 | 26 | 68.42 | 7 | 18.42 | 5 | 13.16 | 38 |
| 50 | 16 | 51.61 | 9 | 29.03 | 6 | 19.35 | 31 |
| 60 | 17 | 43.59 | 12 | 30.77 | 10 | 25.64 | 39 |
| 70 | 19 | 65.52 | 6 | 20.69 | 4 | 13.79 | 29 |
| 80 | 14 | 48.28 | 5 | 17.24 | 10 | 34.48 | 29 |
| 90 | 16 | 44.44 | 8 | 22.22 | 12 | 33.33 | 36 |
| 100 | 20 | 55.56 | 9 | 25.00 | 7 | 19.44 | 36 |
| Total | 222 | 58.58 | 81 | 21.37 | 76 | 20.05 | 379 |

As majority of respondents were still willing to pay a higher amount, a follow-up referendum question was constructed for those respondents who wished to make an additional payment. The majority of respondents (80.18%) who voted 'For the proposal' were willing to make an additional payment, whereas 19.82% did not wish to make any additional payment (Table 7). One third of respondents (33.78%) were willing to pay the same amount as they stated in the initial question. About 13.51%, 18.47%, and 14.41% of respondents were willing to pay half, twice, and more than twice the initial amount, respectively.

Table 7. Respondents' willingness to make an additional payment in a ballot proposal to purchase land to increase open space preservation associated with waterfront areas based on a 2015 mail survey conducted in four coastal cities of Alabama and Mississippi.

| Payment amount ($) | Number of responses in each category | | | | | | | | | | Total responses in a category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No | | About half the amount | | The same amount | | About twice the amount | | More than twice the amount | | |
| | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % | |
| 1 | 3 | 10.34 | 2 | 6.90 | 9 | 31.03 | 5 | 17.24 | 10 | 34.48 | 29 |
| 10 | 3 | 10.71 | 2 | 7.14 | 6 | 21.43 | 8 | 28.57 | 9 | 32.14 | 28 |
| 20 | 4 | 18.18 | 2 | 9.09 | 6 | 27.27 | 7 | 31.82 | 3 | 13.64 | 22 |
| 30 | 2 | 13.33 | 1 | 6.67 | 8 | 53.33 | 2 | 13.33 | 2 | 13.33 | 15 |
| 40 | 5 | 19.23 | 5 | 19.23 | 10 | 38.46 | 5 | 19.23 | 1 | 3.85 | 26 |
| 50 | 4 | 25.00 | 1 | 6.25 | 5 | 31.25 | 4 | 25.00 | 2 | 12.50 | 16 |
| 60 | 5 | 29.41 | 2 | 11.76 | 7 | 41.18 | 1 | 5.88 | 2 | 11.76 | 17 |
| 70 | 5 | 26.32 | 3 | 15.79 | 9 | 47.37 | 1 | 5.26 | 1 | 5.26 | 19 |
| 80 | 3 | 21.43 | 5 | 35.71 | 4 | 28.57 | 2 | 14.29 | 0 | 0.00 | 14 |
| 90 | 5 | 31.25 | 3 | 18.75 | 7 | 43.75 | 0 | 0.00 | 1 | 6.25 | 16 |
| 100 | 5 | 25.00 | 4 | 20.00 | 4 | 20.00 | 6 | 30.00 | 1 | 5.00 | 20 |
| Total | 44 | 19.82 | 30 | 13.51 | 75 | 33.78 | 41 | 18.47 | 32 | 14.41 | 222 |

There were numerous reasons reported by respondents for their votes for the ballot proposal (Table 8). Most respondents (91.44%) who voted 'For the proposal' believed waterfront open space provided social benefits, 86% believed it provided environmental benefits, and 77.93% thought it contributed to the coastal character of the community. In terms of those who did not support the ballot, 72.84% of respondents believed there were already too many taxes (although the scenario was an addition to a water bill payment, not increased taxes), 37.04%

555 indicated that the offered bid amount was too high, and 35.80% thought there were more
556 important uses of tax funds. A relatively small proportion of respondents (13.58%) did not
557 understand the scenario, whereas 7.41% believed there was already enough open space in their
558 community.

559 Table 8. Reasons for voting 'For the proposal' or 'Against the proposal' in the ballot proposal to
560 purchase a land to increase open space preservation associated with waterfront area (multiple
561 answers) based on a 2015 mail survey conducted in four coastal cities of Alabama and
562 Mississippi [a].

| Reasons | Proportion of respondents who voted 'yes' for the proposal (%) | Proportion of respondents who voted 'no' for the proposal (%) |
|---|---|---|
| Provide/increase environmental benefits of open space | 86.04 | Not applicable |
| Provide/increase social benefits of open space (e.g., recreation, increased property values, support traditional waterfront uses) | 91.44 | Not applicable |
| Retain the coastal character of the community | 77.93 | Not applicable |
| There are too many taxes already | Not applicable | 72.84 |
| There are more important uses for tax money | Not applicable | 35.80 |
| There is already enough open space in my city | Not applicable | 23.46 |
| The payment is too high | Not applicable | 37.04 |
| Don't know/no answer | Not applicable | 7.41 |
| I didn't understand the scenario | Not applicable | 13.58 |

563 [a] Total can sum up more than 100% as respondents were allowed to select multiple answers.
564

565 Tables 9 and 10 illustrate the bounds of WTP (lower and upper) used as a dependent
566 variable in estimating the median WTP for the SR and the DR models. The tables illustrate the
567 number of responses at each payment level. In the SR, left-censored represents the total number
568 of respondents (61) who voted 'Against the proposal' at a proposed payment level and right-
569 censored represents the total number of respondents (184) who voted 'For the proposal' at a

570 proposed payment level (Table 9). The SR model had unknown bounds on WTP either in a lower
571 bound as represented by negative infinity or an upper bound as represented by positive infinity.
572 Bounds of WTP were later updated using a follow-up referendum question that reduced
573 unknown upper bounds (a positive infinity) from 75.10% to 11.84%; however, lower bounds
574 (negative infinity) remained the same (24.90%) because the survey only consisted of a follow-up
575 question for the respondents who voted 'For the proposal'. More information on respondents
576 WTP was obtained in the DR as the range of payment level increased to $300 (Table 10).

577
578 Table 9. Bounds on willingness to pay (WTP) for a single referendum (SR) interval-censored
579 model to estimate marginal WTP to support open space preservation associated with waterfront
580 areas in four coastal cities of Alabama and Mississippi based on a 2015 mail survey.

| Bid | Lower bound | | Upper bound | |
|---|---|---|---|---|
| | N | % | N | % |
| Left-censored (- ∞) | 61 | 24.90 | | |
| $1 | 22 | 8.98 | 3 | 1.22 |
| $10 | 21 | 8.57 | 7 | 2.86 |
| $20 | 18 | 7.35 | 3 | 1.22 |
| $30 | 14 | 5.71 | 3 | 1.22 |
| $40 | 20 | 8.16 | 3 | 1.22 |
| $50 | 12 | 4.90 | 7 | 2.86 |
| $60 | 16 | 6.53 | 10 | 4.08 |
| $70 | 16 | 6.53 | 6 | 2.45 |
| $80 | 14 | 5.71 | 4 | 1.63 |
| $90 | 13 | 5.31 | 6 | 2.45 |
| $100 | 18 | 7.35 | 9 | 3.67 |
| Right-censored (+ ∞) | | | 184 | 75.10 |
| Total | 245 | | 245 | |

581 Note: Left-censored and right-censored observations were replaced with $0 and respondent
582 income, respectively, in bounded models.

583 Table 10. Bounds on willingness to pay (WTP) for a double referendum (DR) interval-censored
584 model to estimate marginal WTP to support open space preservation associated with waterfront
585 open areas in four coastal cities of Alabama and Mississippi based on a 2015 mail survey.

| | Lower bound | | Upper bound | |
|---|---|---|---|---|
| Bid | N | % | N | % |
| Left-censored (-∞) | 61 | 24.90 | | |
| $1 | 2 | 0.82 | 5 | 2.04 |
| $1.5 | 2 | 0.82 | 0 | 0.00 |
| $2 | 6 | 2.45 | 2 | 0.82 |
| $3 | 12 | 4.90 | 9 | 3.67 |
| $10 | 3 | 1.22 | 10 | 4.08 |
| $15 | 1 | 0.41 | 0 | 0.00 |
| $20 | 7 | 2.86 | 7 | 2.86 |
| $30 | 16 | 6.53 | 14 | 5.71 |
| $40 | 9 | 3.67 | 7 | 2.86 |
| $45 | 1 | 0.41 | 0 | 0.00 |
| $50 | 3 | 1.22 | 10 | 4.08 |
| $60 | 26 | 10.61 | 28 | 11.43 |
| $70 | 3 | 1.22 | 9 | 3.67 |
| $80 | 10 | 4.08 | 12 | 4.90 |
| $90 | 8 | 3.27 | 19 | 7.76 |
| $100 | 9 | 3.67 | 13 | 5.31 |
| $105 | 3 | 1.22 | 0 | 0.00 |
| $120 | 17 | 6.94 | 12 | 4.90 |
| $135 | 3 | 1.22 | 0 | 0.00 |
| $140 | 9 | 3.67 | 3 | 1.22 |
| $150 | 8 | 3.27 | 7 | 2.86 |
| $160 | 4 | 1.63 | 5 | 2.04 |
| $180 | 8 | 3.27 | 11 | 4.49 |
| $200 | 4 | 1.63 | 4 | 1.63 |
| $210 | 1 | 0.41 | 9 | 3.67 |
| $240 | 2 | 0.82 | 6 | 2.45 |
| $270 | 1 | 0.41 | 5 | 2.04 |
| $300 | 6 | 2.45 | 9 | 3.67 |
| Right-censored (+∞) | | | 29 | 11.84 |
| Total | 245 | | 245 | |

586 Note: Left-censored and right-censored observations were replaced with $0 and respondent
587 income, respectively, in bounded models.

588 Associations of different variables with respondents' WTP were initially examined at the
589 10% or better level of significance. Table 11 results indicated that all coefficient signs for
590 significant variables were the same for the both SR and DR models. As the DR model used a
591 follow-up question to update a payment range, the coefficients in the DR were smaller in
592 magnitude than in SR model producing narrower welfare estimates. Several variables, including
593 FUTDEV, ENVINDEX, SSINDEX, and RENT, were not significant in either model, suggesting
594 these variables did not have any relation with WTP to preserve waterfront open space.
595 Four variables including GOVTRESP, RESD, AGE, and INC were related with WTP in
596 both models at the 10% or better level of significance. For example, respondents who believed
597 that the government had a responsibility to the public to provide usable open space were willing
598 to pay $175.00 and $68.66 more than those who did not believe government had such
599 responsibility in SR and DR models, respectively. Similarly, respondents who resided in the
600 community more than 15 years were willing to pay $98.54 (SR) and $46.74 (DR) less than
601 whose residency was shorter than 15 years. Respondents who were older than 65 years of age
602 were willing to pay $112.28 (SR) and $56.96 (DR) less than those who were younger than 65
603 years. Household income had a positive relation with WTP and respondents who earned more
604 than $65,000 were willing to pay $65.81 (SR) and $39.15 (DR) more than who earned less than
605 that. Variables, GTINDEX and AR, were significant at 10% level in the DR unbounded model
606 only. Respondents who considered gaming and tourism as an important element of the coastal
607 character were willing to pay $23.27 less than those who did not believe so. Respondents who
608 were older than 65 years and resided more than 15 years in the community were willing to pay
609 $55.60 more than those who were younger than 65 years and resided less than 15 years in the
610 community.

611 Table 11. Estimates for single and double unbounded interval-censored models used to estimate
612 values associated with open space preservation associated with waterfront areas in four coastal
613 cities in Alabama and Mississippi based on a 2015 mail survey.

| Variable | SR unbounded | | DR unbounded | |
|---|---|---|---|---|
| | Coef./Marginal WTP | Std. Err. | Coef./Marginal WTP | Std. Err. |
| INTERCEPT | -158.968 | 135.782 | -53.359 | 51.460 |
| GROUP | 64.687 | 42.251 | 32.936** | 14.176 |
| FUTDEV | 63.745 | 80.492 | 35.470 | 37.768 |
| OPENUSE | 72.320 | 45.481 | 14.032 | 16.114 |
| GOVTRESP | 175.020* | 97.027 | 68.662** | 32.238 |
| ENVINDEX | 48.055 | 39.154 | 17.819 | 15.319 |
| GTINDEX | 22.389 | 33.089 | -23.467* | 12.812 |
| SSINDEX | -61.014 | 43.985 | -9.317 | 13.697 |
| RESD | -98.535* | 56.118 | -46.735** | 16.086 |
| AGE | -112.277* | 74.224 | -56.956** | 24.906 |
| AR | 105.386 | 75.618 | 55.599* | 28.486 |
| GENDER | -58.632 | 37.603 | -6.237 | 11.779 |
| EDU | 60.111 | 37.078 | 15.698 | 12.790 |
| INC | 65.815* | 38.154 | 39.152** | 12.837 |
| RACE | 65.868 | 44.714 | 28.535* | 15.870 |
| RENT | 0.975 | 44.513 | 19.703 | 19.175 |
| Sigma | 130.640 | 55.641 | 79.479 | 4.692 |
| Observation | 245 | | 245 | |
| Log likelihood | -104.759 | | -651.326 | |
| LR chi2 (15) | 60.810 | | 56.390 | |
| Prob> chi2 | 0.000 | | 0.000 | |

614 * significant at 10%, ** significant at 5%.

615 Results for the zero-income bound model are presented in Table 12. Variables that were
616 significant at 10% significance level both in SR and DR bounded models included GROUP,
617 RESD, AGE, AR, and INC (Table 12). With some exceptions, most parameter coefficients in the
618 bounded model were similar to those from unbounded models in terms of signs and significance.
619 For example, GROUP, OPENUSE, AR, GENDER, and EDUC were significant in the bounded
620 SR model only. Similarly, GOVTRESP and RACE were significant in unbounded DR model
621 only. Estimates from the bounded models were lower than that of unbounded models and were
622 interpreted in a similar fashion as of the unbounded models.

623

624 Table 12. Estimates for single and double bounded interval-censored models used to estimate
625 values of open space preservation associated with waterfront areas in four coastal cities in
626 Alabama and Mississippi based on a 2015 mail survey.

| Variable | SR bounded | | DR bounded | |
|---|---|---|---|---|
| | Coef./Marginal WTP | Std. Err. | Coef./ Marginal WTP | Std. Err. |
| INTERCEPT | 25.156 | 27.874 | 27.212 | 36.568 |
| GROUP | 23.277** | 11.176 | 26.761** | 11.761 |
| FUTDEV | 14.320 | 20.919 | 22.560 | 27.660 |
| OPENUSE | 16.118 | 10.314 | 2.190 | 12.709 |
| GOVTRESP | 40.765** | 17.248 | 32.301 | 22.661 |
| ENVINDEX | 10.019 | 10.490 | 7.113 | 12.212 |
| GTINDEX | -1.131 | 9.828 | -23.313** | 10.494 |
| SSINDEX | -11.794 | 10.642 | -0.447 | 11.213 |
| RESD | -37.837** | 13.730 | -39.455** | 13.441 |
| AGE | -32.895* | 18.117 | -47.275** | 20.097 |
| AR | 38.433* | 20.593 | 47.065** | 23.113 |
| GENDER | -17.536* | 8.967 | -2.304 | 9.631 |
| EDU | 21.365** | 9.280 | 10.436 | 10.412 |
| INC | 23.009** | 9.443 | 29.380** | 10.457 |
| RACE | 14.254 | 10.759 | 17.589 | 12.550 |
| RENT | -3.964 | 13.857 | 15.258 | 15.624 |
| Sigma | 41.98131 | 4.286 | 68.014 | 3.381 |
| Observation | 245 | | 245 | |
| Log likelihood | -145.720 | | -706.789 | |
| LR chi2 (15) | 55.120 | | 45.730 | |
| Prob> chi2 | 0.000 | | 0.000 | |

627 * significant at 10%, ** significant at 5%.

628 Table 13 reports mean and variance of simulated median WTP estimated using the
629 Krinsky and Robb (1986) approach. A mean WTP obtained from SR unbounded model was
630 $162.14 with a confidence interval of $68.01 to $258.13. Similarly, in the DR unbounded, mean
631 WTP was $80.52 with confidence interval $69.50 and $91.70. Variance obtained in the SR
632 unbounded model was substantially larger with a wider confidence interval in comparison to the
633 DR unbounded model. Mean WTP was reduced by half in the DR unbounded model. Mean WTP
634 estimates obtained from SR and DR bounded models were $95.29 (confidence interval: $83.83

635 to $106.77) and $90.72 (confidence interval: $81.78 to $99.74), respectively. Variance for the
636 SR bounded model was relatively larger than the DR model, suggesting the DR model had the
637 ability to reduce the variance. Both, means and variances between the SR and DR models were
638 statistically different at the 1% significance level; however, a difference in mean WTP was
639 relatively small ($5.00). The DR model produced a narrower confidence interval than the SR
640 model in both cases.

641 Table 13. Means, variances, and confidence intervals of median WTP obtained via Krinsky and
642 Robb method (10,000 repetitions) to support open space preservation associated with waterfront
643 areas in four coastal cities in Alabama and Mississippi based on a 2015 mail survey.

| Models | Unbounded | | | | Bounded | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean WTP | Variance | 95% CI | | Mean WTP | Variance | 95% CI | |
| SR* | 162.14 | 2323.46 | 68.01 | 258.13 | 95.29 | 34.90 | 83.83 | 106.77 |
| DR* | 80.52 | 32.07 | 69.50 | 91.70 | 90.72 | 20.92 | 81.78 | 99.74 |

644 *Means and variance between SB and DB were significantly different at 1% level of significance

645 **1.4 Discussion**

646 This study has demonstrated how attitudes towards open space and resident
647 characteristics were related to willingness to support waterfront open space preservation via a
648 monetary contribution. Overall, findings suggested that the majority of respondents viewed
649 waterfront open space preservation as important to their community's culture and identity, and
650 were willing to pay to support preservation of such spaces.

651 Many communities in the U.S. are facing challenges related to the preservation of open
652 space by limiting urban sprawl while providing commercial and economic growth (Daniels &
653 Lapping, 2005). The majority of respondents in this study believed that commercial development
654 was the major growth issue in the community and believed urban development threatened local
655 identity and environmental quality. Thus, a land use policy should consider preservation of open
656 space in maintaining environmental quality. Local government initiatives in formulating

657 regulations, such as zoning (Longley, Batty, Shepherd, & Sadler, 1992) and urban growth
658 boundaries (Frenkel, 2004), as well as voluntary actions, such as conservation easements (Cho et
659 al., 2005) may be effective because most respondents believed local government was responsible
660 for providing useable open space and that waterfront open spaces should be protected using
661 public initiatives. Moreover, respondents who believed in government responsibility were
662 willing to pay more for open space preservation than those who did not belong to this group. As
663 well, most respondents believed that elements of open space such as closeness to nature, good
664 place for family, and a favorable climate were more important compared to gaming (an
665 important income generator in the region), suggesting initiatives to build support for open space
666 preservation efforts must also pay attention to aesthetic, visual, and environmental dimensions of
667 the program in addition to promotion of gaming industries. The study also revealed that most
668 respondents frequently used open space for various purposes, such as recreation and tourism,
669 suggesting its importance to residents' everyday life.
670 For all econometric models, most of the coefficient signs were as expected; however,
671 there were some differences in significance of individual variables across SR and DR models.
672 The regression models suggested that respondents' involvement in conservation-oriented
673 organizations was a significant factor in their willingness to support waterfront open space
674 preservation. Thus, conservation organizations can serve as a platform for disseminating
675 information related to open space preservation (also see Langpap 2004). Duration of residence
676 (more than 15 years) resulted in a smaller WTP. The inverse relationship between residency
677 duration and WTP for open space preservation is consistent with previous findings that newer
678 residents placed relatively higher value on amenities and conservation than long-time residents
679 (Cho et al., 2005; Dubbink, 1984; Healy & Short, 1979; Johnston et al., 2003). Research

680 suggested that new residents perceived community differently and demonstrated higher demand
681 for ecosystem services than long-term residents (Kelsey, 1998). Thus, new residents had stronger
682 preferences towards environmental attributes and were willing to support monetarily their
683 conservation (Johnston et al., 2003). Similarly, respondents who were older than 65 years were
684 also less willing to pay for open space preservation supporting the premise that younger
685 generations were more aware of open space benefits and more inclined towards its preservation
686 (Lo & Jim, 2010). By contrast, a positive significant interaction between age and residence
687 revealed that respondents who were older than 65 years and resided longer duration in the
688 community were willing to pay more to preserve waterfront open space in all models, except the
689 SR unbounded model. A strategy that targets older residents who have resided for a longer
690 duration in the community by providing appropriate information on conservation is likely to
691 enhance open space preservation. Findings also indicated that household income was a
692 significant factor in explaining respondents' willingness to support open space preservation. This
693 finding is consistent with economic theory and most CVM studies related to valuation of open
694 space. For example, Breffle et al. (1998) estimated that households with income greater than
695 $65,000 were willing to pay $131.00 more than households in $35,000 to $65,000 range to
696 preserve 5.50 acres of undeveloped land. Similarly, Majumdar et al. (2011) reported an increase
697 in WTP based on higher income. In short, respondents' age, income, duration of residency, and
698 association with a conservation group had significant impact on WTP, while other potential
699 explanatory variables played a limited role.
700 Of the four models used to estimate WTP, only one model (SR unbounded) resulted in
701 substantially larger mean WTP ($162.14), whereas the other three models produced relatively
702 similar mean WTP estimates ($80.52 to $95.29). The estimates from the bounded model had

703 smaller marginal contributions to WTP compared to the unbounded models due to inclusion of
704 restriction in bounds (zero-income bound) (Kim et al., 2012). In addition, specifying bounds for
705 WTP from zero to income ensured that expected WTP was non-negative, while a follow-up
706 WTP question collected more information on WTP distribution and increased efficiency (Haab
707 & McConnell, 2002). Among the four WTP estimates, the DR models produced narrower
708 confidence intervals with lower variances than the SR models. Findings suggest that DR
709 performed better compared to SR estimates in terms of attaining lower variance.
710 The interval censored model was effective in incorporating follow-up question
711 information and produced more efficient WTP estimates. Inclusion of the zero-income bound
712 produced non-negative WTP and the follow-up WTP question collected more information on
713 WTP distribution and increased efficiency (Haab & McConnell, 2002). Among the four models,
714 the bounded DR model estimated efficient and precise estimates of WTP ($90.72) with a
715 narrower confidence interval and substantially reduced variance. This result is consistent with
716 Fahad & Jing (2018) who used a similar approach in estimating WTP. Generalizing this WTP
717 estimate to the 2015 households of the study area (119,457) (U.S. Census Bureau 2017)
718 suggested a total monetary value of $10.84 million, which indicates a potential budget necessary
719 to facilitate preservation of open space and its ecosystem service benefits in the four surveyed
720 cities.
721 This study contributes to the growing empirical literature on valuation of open space in
722 several ways. First, it focused on the analysis of public support towards open space preservation
723 and resident willingness to pay to facilitate such preservation, which will be helpful in allocating
724 future budgets for open space preservation in the region, prioritizing future open space
725 preservation efforts, and developing suitable zoning guidelines (Lo & Jim, 2010; Schmidt &

726 Paulsen, 2009). Second, the study analyzed waterfront open space preservation as distinct
727 category. This information will help city planners and other stakeholders to make benefit-cost
728 analyses for various land development and open space preservation scenarios. Third, there is
729 little empirical evidence related to the value of waterfront open space in the urban context and
730 this study helps determine importance of open space in urban setting and provides baseline
731 monetary information that will help facilitate future discussions related to city-specific as well as
732 region-wide land-use priorities. Fourth, the study included some of the new explanatory variables
733 to explain residents support for open space preservation such as those related to important
734 features of coastal characters, importance of future development in preserving coastal characters,
735 and importance of government in providing usable open space. This information will be useful to
736 local government and land-use practitioners because it helps identify relative priorities in terms
737 of open space preservation versus residential and commercial development, which will facilitate
738 development of more community-oriented master plans and identification of long-term land-use
739 priorities.

740 This study has several limitations. The survey did not ask a follow-up question for those
741 respondents who voted against the proposal pertaining to open space preservation associated
742 with waterfront areas and assumed their lower willingness to pay to be "zero". Having a follow-
743 up question for the respondent who voted against the proposal might produce more precise WTP
744 estimates. Therefore, future research using a double referendum question should include follow-
745 up questions for both types of respondents (who voted yes and no). The study also did not
746 differentiate between respondents' preference for working waterfronts vs. another type of
747 waterfront open space. Working waterfronts have substantial contributions to local and state
748 economies as they create jobs. Thus, some residents might prefer working waterfronts over other

749 waterfront open space, which might have impacted WTP estimates. In addition, periodic follow-
750 up studies are warranted as they provide information on changing residents' attitudes towards
751 open space and in redesigning conservation programs to meet open space demand.

752 **1.5 Conclusions**

753 State and local governments, city planners, conservation organizations, trusts, and other
754 agencies tasked with open space preservation often have to balance different and potentially
755 competing land uses. Public opinion surveys are thus crucial for policy debates in attempting to
756 balance economic growth with other elements of social well-being. This study quantified a
757 monetary value of different types of open space associated with waterfronts and identified
758 resident attitudes towards commercial and residential growth, economic development, and open
759 space preservation. Such information is important to city planners and budget managers as it
760 helps quantify benefits of open space and prioritize conservation efforts from a public
761 perspective.

762 The results from the research have several management implication sections. Coastal
763 residents regularly used open space suggesting its importance in everyday life. Therefore, as
764 managers who work to rehabilitate existing open space and create new areas cannot treat these
765 areas as a social island. It is crucial to consider how these areas will be affected by social
766 dimension and vice versa. Similarly, on average, residents were willing to pay $90.72 per
767 household to preserve open space, which translated to an aggregated value of waterfront open
768 space benefits in the study area at $10.84 million. Information on an aggregated value of
769 waterfront open space might serve as a baseline information for determining future budgets
770 allocated towards land acquisition to preserve open space benefits. Findings revealed that most
771 residents were willing to support open space preservation suggesting that Gulf of Mexico has a

772 potential for increasing production of open space benefits and thus policies facilitating open
773 space preservation will be beneficial.

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