SUPPORTING STATEMENT – PART B

B. COLLECTIONS OF INFORMATION EMPLOYING STATISTICAL METHODS

1. Survey Objectives, Key Variables and Other Preliminaries.

1(a) Survey Objectives

The purpose of the survey is to provide necessary data for analyzing the net economic value of beach re-nourishment. U.S. Army Corps of Engineers (USACE) Principle and Guidelines stipulate that when beach visitation exceeds the 750,000 annual visitation threshold, contingent valuation (CV) or travel cost method (TCM) are the required metrics for measuring benefits accruing from recreation. Specifically, the survey will collect data for San Juan and Rincon, Puerto Rico. The project was initially designed to collect onsite data for additional study sites: Dade County FL, Pinellas County FL, Colliers County FL, and Folly Beach SC. COVID-19 pandemic prohibited onsite data collection. Alternative data sources were found for these counties, but no data are available for Puerto Rico. Thus, we will collect onsite data at the beaches of San Juan and Rincon.

The survey instrument will focus on revealed and stated preference data relevant for analysis of beach erosion management and attitudinal, knowledge, and demographic factors that influence recreation behavior and Willingness-to-Pay (WTP) for beach preservation. Survey elements specifically relevant for valuation include revealed preference (RP) recreation trips, contingent behavior (CB) recreation trips under diverse environmental conditions, and stated preference (SP) for beach erosion management plans. The study will employ an experimental design to assess preferences for beach erosion management and will test for internal validity through evaluating the influence of attitudinal, knowledge, and demographic factors on behavior and WTP.

The surveys have been designed to produce data to support the following specific objectives:

- Provide empirical estimates of the value of beach day for visitors (single and multi-day) within the TCM and SP frameworks.
- Employ the SP and TCM to develop valid and reliable estimates of recreation NED benefits.
- Estimate the changes in recreation demand that might occur with beach nourishment and parking improvements necessary to satisfy the requirements for USACE Engineers cost-share.
- Estimate economic models of household preference and quantify benefits, non-use values, and environmental costs associated with beach management

1(b) Key Variables

The key questions in the survey ask respondents about their historical and planned/hypothetical trips to the beach they are currently visiting and whether or not they would vote for coastal erosion policies that would preserve or enhance beach width and potentially have other impacts on beach recreation (e.g., access, parking, environmental impacts of management, etc.). Stated preference analysis will utilize choice experiments. The choice experiment framework allows respondents to view a set of multi-attribute policies associated with erosion management plan. Respondents are asked to choose one of the options. Typically, one option is a status quo (i.e. maintain current programs with no additional household costs) and other options correspond with programs that yield improvements in some or all of the environmental attributes specified. The survey design follows well-established choice experiment methodology (Adamowicz et al. 1998; Louviere et al. 2000; Bennett and Blamey 2001; Bateman et al. 2002).

The survey focuses on environmental and ecological "endpoints" that are potentially relevant for households' recreation experience and non-use values. Thus, the survey presents respondents with changes in attributes that can directly affect household utility/satisfaction. Specifically, the survey presents changes in the following attributes: (a) reduction in beach width due to natural erosion, (b) beach width maintained at current width, (c) enhanced beach width, (d) presence/absence of negative environmental impacts associated with beach nourishment, (e) beach access points, (f) availability of convenient parking, and (g) congestion levels. As discussed by Boyd and Krupnick (2009), these endpoints are aspects of the environment and management programs that people experience, that can influence their choices, and that previous research has found to be tangible for households.

1(c) Statistical Approach

For the onsite sample, we will intercept users at or nearby the beach in order to target beach users (presumably those most affected by beach erosion management). Paid enumerators will hand out printed surveys on clipboards and give respondents ample time to fill out the survey before returning for collection. We will record beach trips and trips attributes for the previous 3 months, while also collecting information on planned trips, contingent behavior with environmental and policy change, and contingent value data. We will use standard approaches to deal with endogenous stratification/avidity bias. Econometric models will include single-site demand and joint RP/SP preference models.

1(d) Feasibility

Due to the tropical climate, domestic beach visitation in Puerto Rico lacks a strong seasonal component. Thus, sampling in the summer and fall should provide a suitable basis for analysis of domestic beach use. International tourism, however, does have a seasonal component and is generally stronger in the winter for the northern hemisphere (over 90% of international visitors originate from the United States). We plan to augment the sample with data from the winter to accommodate the swell in international travelers. There are no regulations or restrictions that would prohibit beach surveys in Puerto Rico.

2. Survey Design

2(a) Target Population and Coverage

Eligible respondents for this revealed and stated preference survey are individuals 18 years of age or older that reside in Puerto Rico or are visiting the island for the purpose of recreation, leisure, and tourism. Puerto Rico residents comprise the target population for the domestic survey. Puerto Rico visitors comprise the target population for the visitor survey.

2(b) Sampling Design

(i) Sampling Frame

The sampling frame for this research consists of Puerto Rico residents and visitors. Both surveys will collect beach visitation data. The domestic Puerto Rico survey will be conducted in 2 waves, recording trips to the beach over the previous 3 months. The shorter time horizon for reporting beach trips (in comparison to the commonly used previous 12 months) was determined necessary given the frequency of beach trips among Puerto Ricans. Twelve-month recall would be too difficult and may results in bias. Two waves measuring trips over the previous 3 months will provide a thorough profile of beach visitation and preferences for beach erosion management among Puerto Rico residents. The survey also includes protocol to assess whether and how trips have been affected by the COVID-19 pandemic.

The tourist survey will also be sampled in two waves, including the winter (to capture the peak season of visitors from US). The tourist survey will capture past trips (2018 to 2022) to the Caribbean and assess the appeal of Puerto Rico beaches relative to other Caribbean destinations. Past trip taking behavior provides a basis for assessing recreation demand to the Caribbean and the destination image of Puerto Rico and its beaches in comparison to other island destinations.

(ii) Sample Sizes

The target responding sample size for the survey is 940 completed surveys. This sample size was chosen to provide statistically robust regression modeling while minimizing the cost and burden of the survey. Given this sample size, the level of precision achieved by the analysis will be adequate to meet the analytic needs of the benefits analysis.

(iii) Stratification Variables

Given the screening inherent in onsite sampling, we will not employ stratification.

(iv) Sampling Method

Onsite sampling is effective when researchers need to sample resource users. The downside of onsite sampling is truncation of non-users, avidity bias, and endogenous stratification. A lack of information on non-users can be an issue if the researcher wants to explore strategies that might bring in new visitors. Avidity bias occurs because more frequent visitors are more likely to be sampled. Endogenous stratification is an issue in statistical analysis that arises due to stratification by a key dependent variable (recreation trips). We will employ standard weighting techniques to address these issues.

(v) Multi-Stage Sampling

While we will collect multiple seasons of data, we will not utilize multi-stage sampling techniques.

2(c) Precision Requirements

(i) Precision Targets

The survey seeks data on a number of important aspects of behavior that will inform USACE beach erosion management policy; these include previous RP trips and travel costs associated with travel to the site, planned contingent behavior (CB) trips associated with changes in site quality, and stated preference (SP) data. The first element can be used to estimate primary recreation benefits under status quo conditions utilizing single-site demand estimation, while controlling for onsite sampling (Shaw 1988; Englin and Shonkwiler 1995; Landry, et al. 2016). The second element, in combination with RP trips, can be used to simulate demand change, and thus use value associated with changes in site characteristics (e.g. beach width, access, parking, congestion, etc.). The last element can be used to assess use and non-use value and the value of erosion-program attributes, but when all the data are combined, utility-theoretic structural models can be estimated that permit testing for non-use value and separation of use and non-use values.

Since the RP data are standard for primary site assessment, we can consider the question of how much data are needed to identify changes in the demand equation. Since variation in key characteristics (like beach width) provide for experimental assessment of changes in recreation value, we can focus this question on identification of changes in value associated with a binary treatment (as defined by the CB data). Pre-tests at Pinellas County beaches (Musci, Hindsley, and Landry 2019) indicate a grand mean of 5.297 trips per year for single-day visitors, with a standard deviation of 1.746. (The mean and standard deviation for multi-day trips are each smaller.) Given that Puerto Ricans are likely to make many more trips to the beach in a year, we use these benchmarks as indicators of beach demand over a quarter-year. Following List et al. (2011), efficient sample size can be defined as:

$$N = (\tau_{(1-\kappa)} + \tau_{2\alpha})^2 \times \frac{\sigma^2}{\delta^2} = (1.660 + 1.984)^2 \times 3.048/0.15 = 270,$$

where $\tau_{(1-\kappa)}$ indicates statistical power (which we set to 90% chance of avoiding a type two error), $\tau_{2\alpha}$ is the significant level (probability of type one error), σ is variability of the trip data, and δ is the minimum detectible effect size (Duflo et al. 2007). Thus, with a sample size of 270, we should be able to detect changes in recreation demand of 0.15 (which is quite small relative to the mean and variance). Thus, we intend to collect 270 observations per wave, for 540 over 6 months (2 waves).

For the U.S. tourist dataset, we do not have sufficient information on demand to conduct power analysis. Heuristics suggest 400-500 observations are generally adequate for a well-designed SP survey implemented onsite. Thus, we intend to collect 400 total responses from past Caribbean visitors.

3. Pre-tests

Surveys have been pre-tested to ensure understandability and reliability, and survey questions have been designed to introduce elements of incentive compatibility. Internal validity and consistency checks have been included in the project and survey design. The basic survey instrument has been pre-tested as a part of different projects, employed in North Carolina in 2010 and repeatedly in Pinellas County, Florida from 2014 to the present. These projects have produced two publications (Gopalakrishnan, et al. 2016; Landry, Shonkwiler, and Whitehead 2020), and a UGA working paper (Musci, Hindsley, and Landry 2019). The current project targets the universe of beach visitors in order to assess use and non-use values associated with beach erosion management.

4. Collection Methods and Follow-up

4(a) Collection Methods

We will employ an access-point-based sampling strategy, a common approach for recreation and tourism sites where there are multiple entry and exit points (Bowker, Bergstrom, & Gil 2007). For each site, we will catalog access points, classify them along a spectrum of high to low use, and obtain a stratified random sample across those access points, with sampling intensity corresponding to level of usage. Classification will also involve recording potential heterogeneous beach visitor types at each site (e.g. some sites may be more popular with surfers, anglers, etc.).

In addition to sampling units being broken down by frequency of use, there will also be a time-of-day component to account for different types of beachgoers who visit in the morning compared to the afternoon.

Morning sampling will run from 8 AM to 12 PM and afternoon sampling will run from 1 PM to 5 PM. Using these two criteria of frequency of use and time of day, sampling units will be developed for each beach season at each study site. The onsite survey will be administered using a pen-and-paper survey instrument. Surveyors will walk in approximate 1-mile increments to the right and left of the beach access site surveying every 3rd beach user group they encounter on busy days (> 70 beach user groups) and all visitors that they encounter on slow days (< 70 beach user groups). If there are multiple people within a party, the beach goer with the most recent birthday will be surveyed to ensure respondents are randomly selected. Surveyors will briefly explain the study and then ask the beach goers to voluntarily participate. If the subjects do not consent to participate, we will employ the following non-response bias protocol.

4(b) Maximization of Response Rates, Non-response, and Reliability

In order to assess non-response bias, before completing the survey or after refusal to complete the survey, we will attempt to ask non-respondent two questions:

- City/State/County of residence
- Number of beach trips [or days onsite]

If we are able to obtain responses to these two questions, it will permit us to estimate the potential magnitude of non-response bias. We will employ Chi-square and Wilcoxson-Mann-Whitney tests to assess differences across respondents and non-respondents.

For subjects that consent to participate, the surveyor will leave a clipboard, survey, and pen with the beachgoer and come back 15-20 minutes later, giving the beachgoer time and privacy to fill out the survey. This also provides the ability for the surveyor to administer other surveys down the beach before doubling back to pick up completed surveys. We plan to provide each surveyor 5-10 clipboards at a time so that he/she can efficiently administer other surveys while other respondents are completing surveys. This type of survey loop will be completed until the end of the sampling time frame.

5. Analyzing and Reporting Survey Results

5(a) Data Preparation

Data will be entered into spreadsheet software by paid laborers. We will employ double-entry protocol to minimize entry errors.

5(b) Analysis

Econometric analysis will include stand-alone and combined models of recreation behavior. Stand-alone models will be estimated first to provide a basis of comparison to previous literature and assess internal validity. Standard recreation demand/valuation models supported by these datasets include single-site recreation demand models for each site, and stated preference analysis, utilizing responses to contingent valuation or choice experiments. Survey questions will be designed to distinguish between different categories of recreational beneficiaries, for example, resident vs. non-resident, day visitor vs. overnight visitor, and onsite activities (Cutter, Pendleton, and DeShazo 2007).

While these basic econometric models are very informative for valuation and policy analysis, we seek more insight from the rich array of data to be collected. Thus, in addition to the standard models, we will also employ structural models that combine the various kinds of data in a consistent way for a more complete assessment of preferences related to beach management. We will explore stacked RP/SP quasi-panel recreation demand models (e.g. Landry and Liu 2009, 2011). Importantly, RP trip data combined with SP trip data permits assessment of changes in aggregate visitation and net economic value for users (e.g. Landry and Liu 2009; Whitehead, et al. 2008, 2010) under various beach nourishment scenarios – including various beach widths and ecological impacts. The aggregate trip data can also be used to assess economic impacts attributable to beach nourishment.

We will estimate structural models that combined recreation demand and SP (Eom and Larson 2006; Huang, et al. 2015; Landry, Shonkwiler, and Whitehead 2019). These models permit direct assessment and estimation of non-use values. We will explore extending the current model formulations to incorporate SP trip data and CE (instead of CV) data. By building upon solid theoretical foundations, empirical results can ultimately be applied within a dynamic optimization framework for beach erosion management (Landry 2008, 2011; Gopalakrishnan, et al. 2016, 2018), and models will be designed so that, to the extent possible, results can be generalized for application to other project assessment exercises via additional onsite data combined with the internet survey, or via benefit transfer (e.g., Van Houtven and Poulos 2009).

6. Consultation and Information Analysis

a. Provide names and telephone number of individual(s) consulted on statistical aspects of the design.

Craig E. Landry: Professor, Ag & Applied Economics, University of Georgia, 706-542-0756

Bynum Boley: Assistant Professor, Forestry, University of Georgia, 706-583-8930

Roger von Haefen: Professor, Ag & Resoure Economics, North Carolina State University, 919-515-8946

Paul Hindsley: Associate Professor, Env. Studies, Eckerd College, 727-864-7722

b. Provide name and organization of person(s) who will actually collect and analyze the collected information.

Craig E. Landry: Professor, Ag & Applied Economics, University of Georgia, 706-542-0756

Roger von Haefen: Professor, Ag & Resoure Economics, North Carolina State University, 919-515-8946

Bynum Boley: Assistant Professor, Forestry, University of Georgia, 706-583-8930

Paul Hindsley: Associate Professor, Env. Studies, Eckerd College, 727-864-7722

REFERENCES

Adamowicz, W., Boxall, P., Williams, M., and Louviere, J. (1998). Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. *American Journal of Agricultural Economics*, *80*(1), 64-75.

Bateman, I. J., Carson, R. T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pierce, D.W., Sugde, R., and Swanson, J. (2002). *Economics valuation with stated preference surveys: A manual*. Northampton, MA: Edward Elgar.

Bowker, J. M., Bergstrom, J. C., & Gill, J. (2007). Estimating the economic value and impacts of recreational trails: a case study of the Virginia Creeper Rail Trail. *Tourism Economics*, *13*(2), 241-260.

Boyd, J. W. and A. Krupnick (2009). The Definition and Choice of Environmental Commodities for Nonmarket Valuation (September 17, 2009). Available at SSRN: https://ssrn.com/abstract=1479820 or http://dx.doi.org/10.2139/ssrn.1479820

Cutter, W.B., L. Pendleton, and J.R. DeShazo. 2007. Activities in Models of Recreation Demand, *Land Economics* 83(3): 370-81.

Duflo, E., R. Glennerster, M. Kremer. (2007). Handbook of Development Economics, Elsevier

Eom Y.S. and D.M. Larson. 2006. Improving environmental valuation estimates through consistent use of multiple information. *Journal of Environmental Economics and Management* 52: 501–16

Englin, J., & Shonkwiler, J.S. 1995. Estimating Social Welfare Count Data Models: An Application to Long-Run Recreation Demand Under Conditions of Endogenous Stratification and Truncation. *The Review of Economics and Statistics, 77,* 104-112.

Gopalakrishnan, S., C.E. Landry, and M. Smith. 2018. “Climate Change Adaptation in Coastal Environments: Modeling Challenges for Resource and Environmental Economists” *Review of Environmental Economics and Policy* Winter, 12(1): 48-68

Gopalakrishnan, S., C.E. Landry, M. Smith, and J.C. Whitehead. 2016. “Economics of Coastal Erosion and Adaptation to Sea Level Rise” *Annual Review of Resource Economics* 8: 13.1-13.21.

Huang J.C., Shaw D., Chien Y.L., Zhao M.Q. 2015. Valuing environmental resources through demand for related commodities. *American Journal of Agricultural Economics* 98(1): 231-53

Landry, C.E., Lewis, A.R., Liu, H., & Vogelsong, H. 2016. Addressing Onsite Sampling in Analysis of Recreation Demand: Economic Value and Impact of Visitation to Cape Hatteras National Seashore. *Marine Resource Economics, 31*, 301-322.

Landry, C.E. 2011. “Coastal Erosion as a Natural Resource Management Problem: An Economic Perspective” *Coastal Management* 39(3): 259-78.

Landry, C.E. and H. Liu. 2009. “A Semi-Parametric Estimator for Revealed and Stated Preference Data: An Application to Recreational Beach Visitation” *Journal of Environmental Economics and Management* 57(2): 205-18.

Landry, C.E., J.S. Shonkwiler, and J.C. Whitehead. 2020. “Economic Values of Coastal Erosion Management: Joint Estimation of Use and Existence Values with Recreation Demand and

Contingent Valuation Data" *Journal of Environmental Economics and Management*, 103(Sept): 1023-64. https://doi.org/10.1016/j.jeem.2020.102364
Landry, C.E. and H. Liu. 2011. "Econometric Models for Joint Estimation of RP-SP Site Frequency Recreation Demand Models" in Preference Data for Environmental Valuation: Combining Revealed and Stated Approaches, Haab, T., J. Huang, and J. Whitehead (Eds), Routledge: New York, NY.
List, J.A., S. Sadoff and Mathis Wagner. 2011. "So You Want to Run an Experiment, Now What? Some Simple Rules of Thumb for Optimal Experimental Design" Experimental Economics 14.
Louviere, J.J., Hensher, D.A., and Swait, J.D. (2000). *Stated preference methods: Analysis and application*. Cambridge, UK: Cambridge University Press.
Parsons, G. R., Chen, Z., Hidrue, M. K., Standing, N., Lilley, J. 2013. Valuing Beach Width for Recreational Use: Combining Revealed and Stated Preference Data. *Marine Resource Economics*, *28*, 221-241.
Shaw, D. 1988. On-Site Samples' Regression: Problems of Non-negative Integers, Truncation, and Endogenous Stratification. *Journal of Econometrics, 37,* 211-223.
Van Houtven, G. and C. Poulos. 2009. Valuing Welfare Impacts of Beach Erosion: An Application of the Structural Benefit Transfer Method, *American Journal of Agricultural Economics* 91: 1343 – 50.
Whitehead, J.C., C.F. Dumas, J. Herstine, J. Hill, and B. Buerger, 2008. Valuing Beach Access and Width with Revealed and Stated Preference Data, *Marine Resource Economics* 23(2): 119-135.
Whitehead, J.C., D. Phaneuf, C.F. Dumas, J. Herstine, J. Hill, and B. Buerger, 2010. Convergent Validity of Revealed and Stated Recreation Behavior with Quality Change: A Comparison of Multiple and Single Site Demands, *Environmental & Resource Economics* 45: 91-112.