# Monetary Values and Restoration Equivalents for Lost Recreational Services on the Gulf Coast of Texas

George R. Parsons
University of Delaware

# Acknowledgement

**Funding for this project was provided by the Coastal Response Research Center**
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NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

# Collaborators

- Christy Poulos, Research Triangle Institute
  - Companion Project
- Eric English
  - NOAA liaison
- Ami Kang & Stu Smith
  - Students

# Purpose

- Develop a recreation demand model of beach use on the Gulf Coast of Texas to value damages due to oil spills and other environmental disruptions

- Two important dimensions of the project
  - Non-Monetary Values (Restoration Equivalents)
  - Short Term Closures

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# Data & Method

- **Data**
  - Stratified random sample of Texas residents
  - Trips and demographics
  - 884 people, 2777 day trips
  - 65 beaches
  - Padre Island
- **Method**
  - Random Utility Model (Choice Model)
  - Infer Values for Closures at Padre Island
  - Simulate

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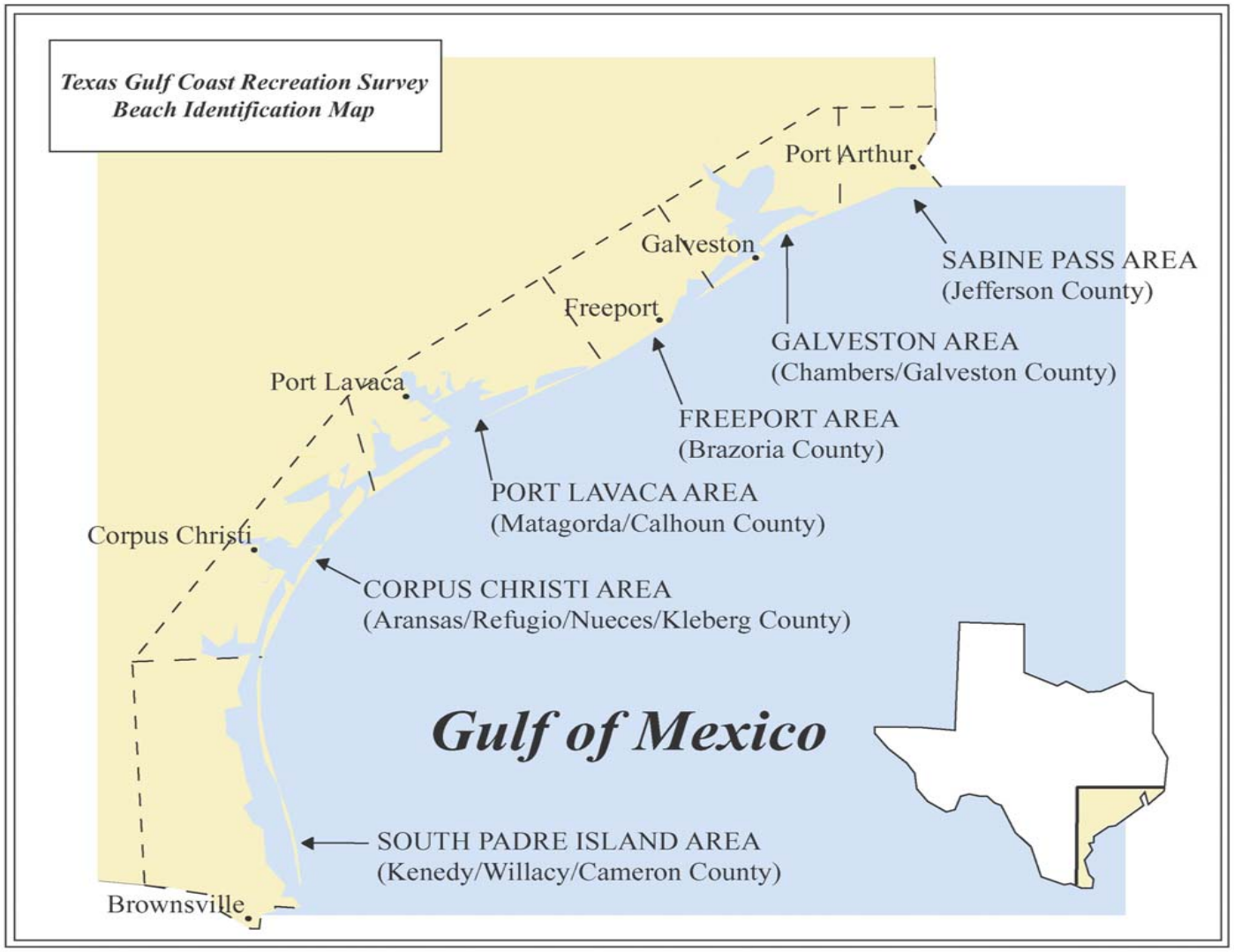


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# Progress

- Non-Monetary Values
  - Updated Site Characteristics/Cleaned Choice Data
  - Estimated model(s) ~ nested/mixed/heterogeneity
  - Monetary values for closure of Padre (plus other)
  - Non-Monetary values for closure of Padre
    - Beach cleaning, facilities, vehicle free areas, (Dune & Width)

- Short Term Closure
  - Data Preparation
  - Preliminaries on SP question
  - Model Development

# Estimation Results: Site Choice

| Variable | Coefficient Estimate | | Variable | Coefficient Estimate |
|---|---|---|---|---|
| Trip Cost | -.022 (27) | | Region2 | 1.1 (3.9) |
| Gulf | .42 (3.0) | | Region3 | 2.0 (4.5) |
| StatePark | .22 (0.8) | | Region4 | .83 (2.3) |
| Padre | 1.25 (5.2) | | Region5 | 1.4 (4.4) |
| Rest Room | .59 (6.3) | | Region6 | 1.6 (4.7) |
| Lifeguard | .22 (2.1) | | Length | .25 (8.3) |
| Concessions | -.51 (5.0) | | Inclusive | .73 (17) |
| Mach Cln | .85 (7.6) | | | |
| Man Cln | .35 (3.0) | | | |
| NoFish | -.069 (.58) | | N = 884 | |
| NoSwim | -.82 (3.7) | | Trips = 2777 | |
| Remote | -.11 (1.0) | | Sites = 65 | |
| Auto Free | .65 (4.9) | | | |
| Auto Free Area | .30 (2.1) | | | |
| Closure | -.74 (3.6) | | | |
| Red tide | -1.63 (5.0) | | | |

# Estimation Results: Participation

| Variable | Coefficient Estimate | | Variable | Coefficient Estimate |
|---|---|---|---|---|
| Constant | -8.4 (20) | | May | .85 (8.1) |
| Weekend | 1.2 (21) | | June | .72 (6.7) |
| Kids | .14 (2.2) | | July | .66 (6.1) |
| Age | -.02 (1.8) | | August | .65 (5.7) |
| Age Sq | .0002 (1.5) | | | |
| Spanish | .11 (1.2) | | | |
| High Sch | -.20 (2.7) | | N = 884 | |
| College | .14 (1.8) | | NonParticipants = 319 | |
| Grad Sch | .43 (4.4) | | Sites = 65 | |
| Full Job | .20 (3.3) | | | |
| Cottage | .33 (3.3) | | | |
| Boat | .41 (6.6) | | | |
| Pool | -.28 (3.9) | | | |
| | | | | |

# Monetary Values

| Scenario | Total Loss for a Week Day in May | Per Trip Loss | Total Loss for a Weekend Day in May | Per Trip Loss |
|---|---|---|---|---|
| Padre Closure | $129,078 | $39.98 | $390,746 | $39.77 |
| Closures | $128,506 | -- | $403,316 | -- |
| Redtide | $386,135 | -- | $1,204,406 | -- |


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# Non-Monetary Values

| Number of Beaches | Manual Clean KH/%Comp | Machine Clean KH/%Comp | Facilities KH/%Comp | Vehicle Free KH/%Comp |
|---|---|---|---|---|
| 1 | .00 .00 | .01 .00 | .01 .00 | .01 .00 |
| 2 | .00 .00 | .01 .00 | .01 .00 | .18 .00 |
| 3 | .00 .00 | .01 .00 | .10 .00 | .29 .00 |
| 4 | .00 .00 | .03 .00 | .12 .00 | .30 .00 |
| 5 | .00 .00 | .03 .00 | .12 .00 | .82 .92 |
| 6 | .00 .00 | .05 .00 | .14 .00 | .83 .92 |
| 7 | .00 .00 | .10 .00 | .14 .00 | .83 .92 |
| 8 | .02 .00 | .31 .05 | .14 .00 | .83 .92 |
| 9 | .02 .00 | .74 .89 | .21 .00 | .83 92 |
| 10 | .02 .00 | .74 .89 | .21 .00 | 1.1 .92 |
| 15 | .03 .05 | .76 .89 | .30 .62 | 1.5 .94 |
| 20 | .03 .05 | .76 .89 | .30 .62 | 1.5 .94 |
| 25 | .04 .05 | .98 .91 | .31 .63 | 1.5 .94 |
| | | | | |

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# Next Steps

- Baseline Paper w/ Monetary Values
- Non-Monetary Paper (Presentations)
  - 'Clean-Up' Current Scenarios
  - Add Width & Dune Line
  - Finalize Mixed Logit
  - Incorporate Mid-Atlantic
    - Width/Park Space/Parking/Access
- Heterogeneity Paper

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# The End

# Backup Slides Follow

# Random Utility Model

- **Model**
  - Predicts beach visitation based on individual and beach characteristics -- **probabilistic**
  - Discrete Choice/Maximum Likelihood Estimation
  - Reveals the relative value of beach characteristics and yields a preference weighted index for each beach used in valuation -- **expected utility of a trip**
- **Values**
  - Compensatory Equivalencies
  - Usually monetary but can be non-monetary
  - Simulate Model to find Equivalencies

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# Model (1)

- **Each respondent *i* is assumed to have some utility for visiting each beach *j* -- depends on individual and site characteristics**

Site Utility → $U(x_i, y_j; \beta) + \varepsilon_{ij}$

Site characteristics

Individual characteristics

# Model (2)

- An individual's probability of choosing a given site, say k, is

$$Pr_i\{k\} = Pr\{U(x_i, y_k; \beta) + \varepsilon_{ik} > U(x_i, y_j; \beta) + \varepsilon_{ij} \text{ for all } j\}$$

- For different assumed distributions of $\varepsilon_{ij}$ we get different forms for $Pr_i\{k\}$
  - Closed-form logit models
  - Simulated probabilities

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# Estimation

- These probabilities are then used to form likelihood functions that express "the likelihood of observing the pattern of trips realized in the data"

  $L = \Pi_i \Pi_j [Pr_i\{j\}]^{y(ij)}$ where y(ij) = 1 if person i visited beach j.

- Choose $\beta$ in the $U(x_i, y_j; \beta)$ to maximize L

# Expected Trip Utility

- Use the estimation results to formulate a expected maximum utility of a trip. This is a preference weighted index that has no 'cardinal' significance but it does reveal the relative importance of beach characteristics to individuals.

$$I_i = I\{U(x_1, y_j; \beta),\ U(x_2, y_j; \beta),\ \ldots\ U(x_{64}, y_j; \beta)\}$$

# Values

- Monetary values seek equivalency measures that equate

$$I\{U(x_1,y_j;\beta),\ U(x_2,y_j;\beta),\ \ldots\ U(x_{64},y_j;\beta)\}$$
$$= I\{U(^*x_1,y_j;\beta),\ \ldots\ U(^*x_{64},y_j;\beta)\}$$

- Non-monetary values seek equivalency measures that equate

$$I\{U(x_1,y_j;\beta),\ U(x_2,y_j;\beta),\ \ldots\ U(x_{64},y_j;\beta)\}$$
$$= I\{U(^*x_1,y_j;\beta),\ \ldots\ U(^*x_{64},y_j;\beta)\}$$

where the second index is missing a site or sites due to a closure and some attributes are added in compensation.

- Could be any number of attributes over one or many sites
  - Beach cleaning, improved access, piers, open space and so forth