Using Onsite Counts to Estimate a Multi-Site, Zonal Travel Cost Model: An Application to the Deepwater Horizon Oil Spill

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Collecting Recreation Data

- **On-Site Counts**
- Often the only cost-effective means of collecting recreational data
- Statistical issues: truncation and endogenous stratification
- Econometric fixes: Shaw (1988); Englin & Shonkwiler (1996); Hindsley, Landry & Gentner (2011)
  - Often rely on strong parametric assumptions
  - Require trip data over a defined reporting period (e.g. year)
    - Susceptible to recall bias
  - Extension to multi-site framework is difficult (Moeltner & Shonkwiler, 2005)

Multi-Site, Zonal Travel Cost Model Approach

- Zonal travel cost models have been around since Hotelling (1947), but few applications in recent years (e.g., Hoagland and Meeks, 2000; help!)
- Generally single site models, a few multi-site (Moeltner, 2003)
- Underlying trip information generally comes from permitting or private vendor sources (not onsite counts)

Current Paper

- Use onsite data to estimate a multi-site, zonal travel cost model of shoreline recreation
- Use the largest on-site data set ever collected
  - N = ~70,000
  - Gulf Coast sites (Louisiana to the Florida Keys) from 2010 to 2013
- Estimate a repeated discrete choice, two-level nested logit model
  - 53 sites
  - ~31,000 zonal origins (zip codes for the contiguous US)
- Estimate the recreational damages from the 2010 Deepwater Horizon Oil Spill
- Compare loss per user day estimates to those generated from a general population phone survey

Key Findings

- Plausible parameter estimates
- Loss per user day from ZTC is similar to that generated from general population phone survey results
  - Despite the fact the phone survey results appear to suffer from significant recall bias
- More generally, alternative strategy for analyzing data collected onsite that avoids shortcomings of existing methods

Background

April 20, 2010 – Deepwater Horizon mobile drilling unit exploded, caught fire, and sank

134 million gallons of oil released over **87 days**

Active shoreline cleanup continued until **April 14, 2014**

Largest Natural Resource Damage Assessment *ever*

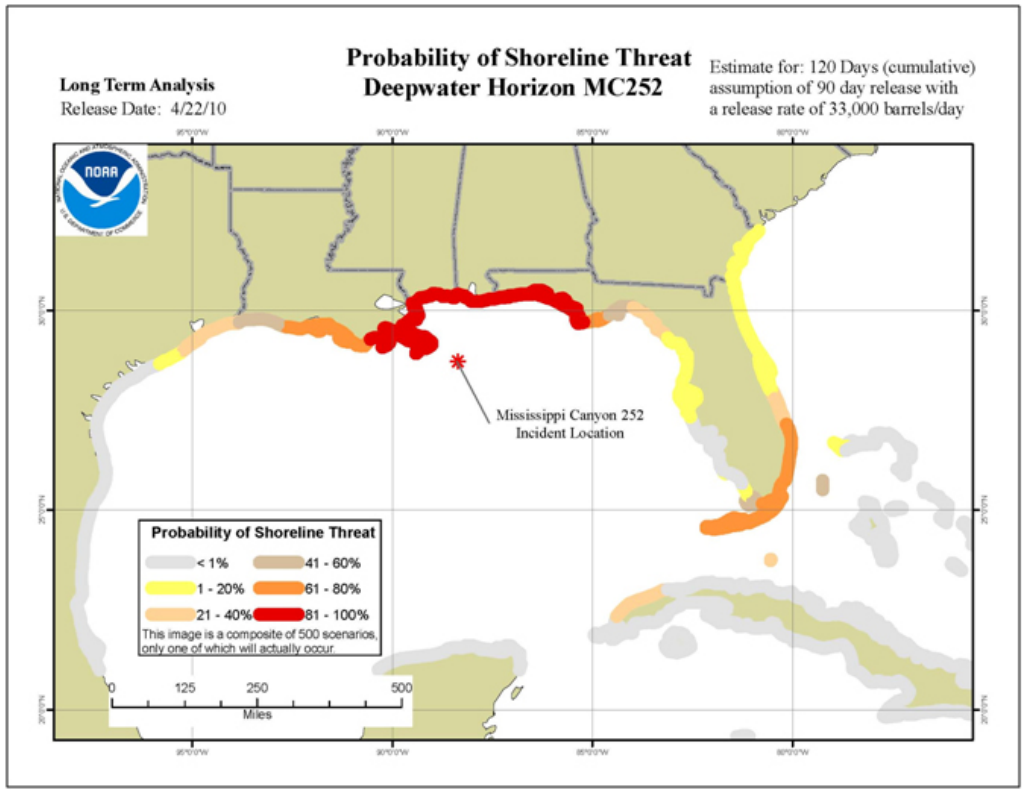
Deepwater Horizon Natural Resource Trustees:

Assessment Team

L to R: Roger von Haefen, Jason Price, Eric English, Adam Domanski, Christopher Leggett, Joseph Herriges, Kenneth E. (Ted) McConnell, Katherine Pease, Norman Meade, Frank Lupi, Mike Welsh, Jason Murray

Not pictured: Roger Tourangeu and over 215 additional support staff

Charge to the Team



Assess lost recreational use due to the DWH incident

Produce an estimate of damages for use in a Natural Resource Damage Assessment claim on behalf of the public

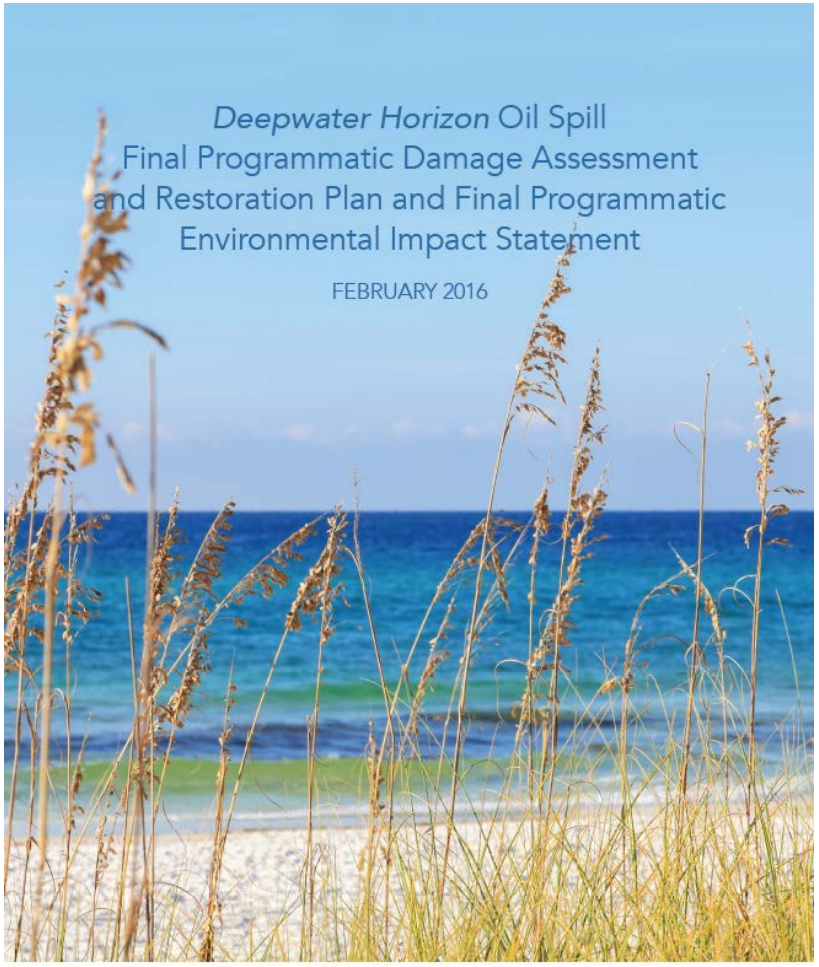
Unique Challenges:

- **Implementation of data collection on short timelines**
- **Trustee coordination**
- **Confidentiality**
- **Document Preservation**

Total Damages

Total lost recreational use damages		
Lower Bound	**Point Estimate**	**Upper Bound**
$528	**$693**	**$859**
in millions of 2015 US dollars		

Outcome



$18.7 billion settlement, **$8.1 billion** of which is for Natural Resource Damages

Final Programmatic Damage Assessment and Restoration Plan (PDARP) that outlines the incident, injury assessment, and restoration plan published in February 2016.

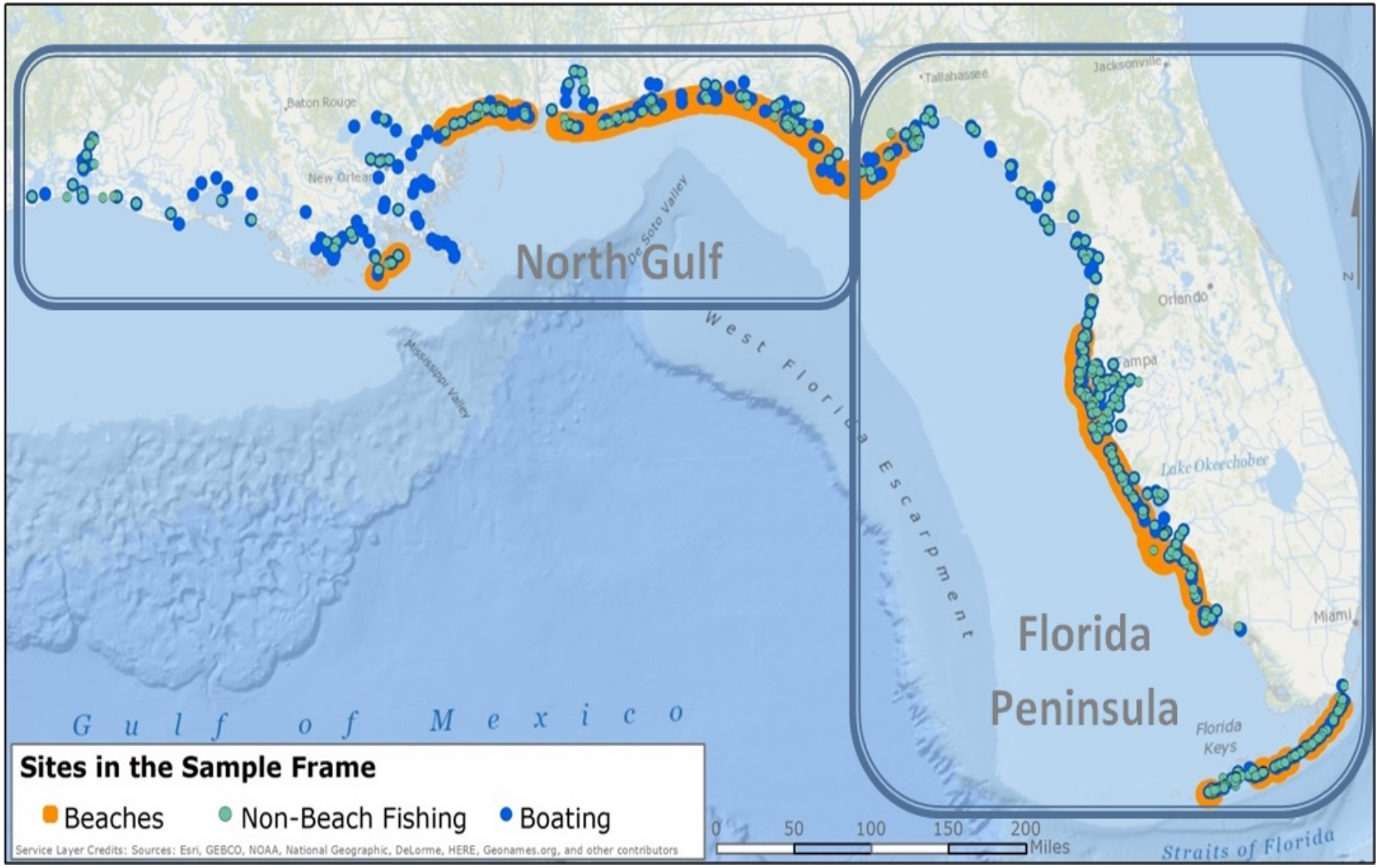
Consent decree approved on April 4, 2016.

PDARP available at http://www.gulfspillrestoration.noaa.gov/

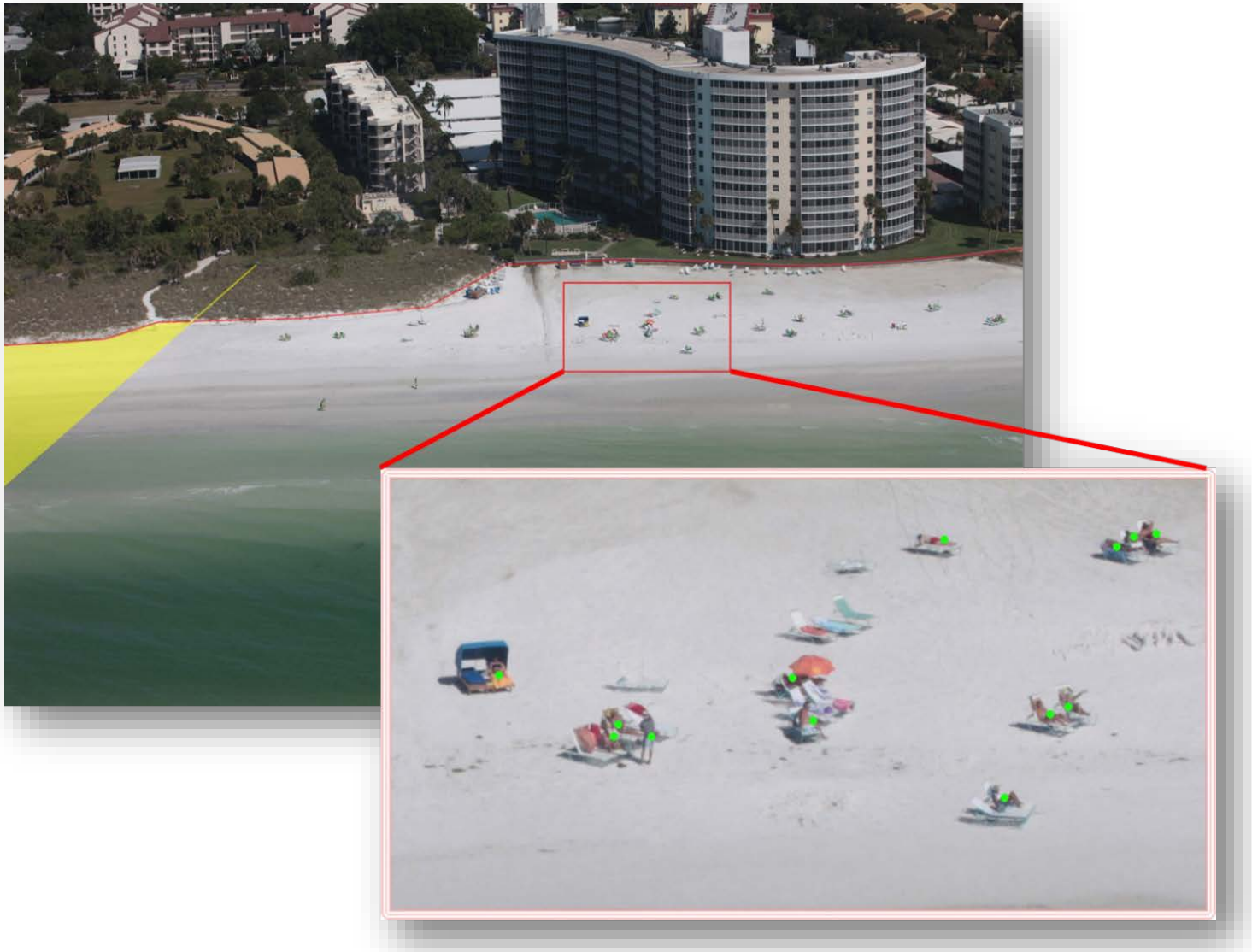
Administrative Record available at https://www.doi.gov/deepwaterhorizon/adminrecord

Data available at https://dwhdiver.orr.noaa.gov/

Counts: Geographic Coverage



Aerial Photography



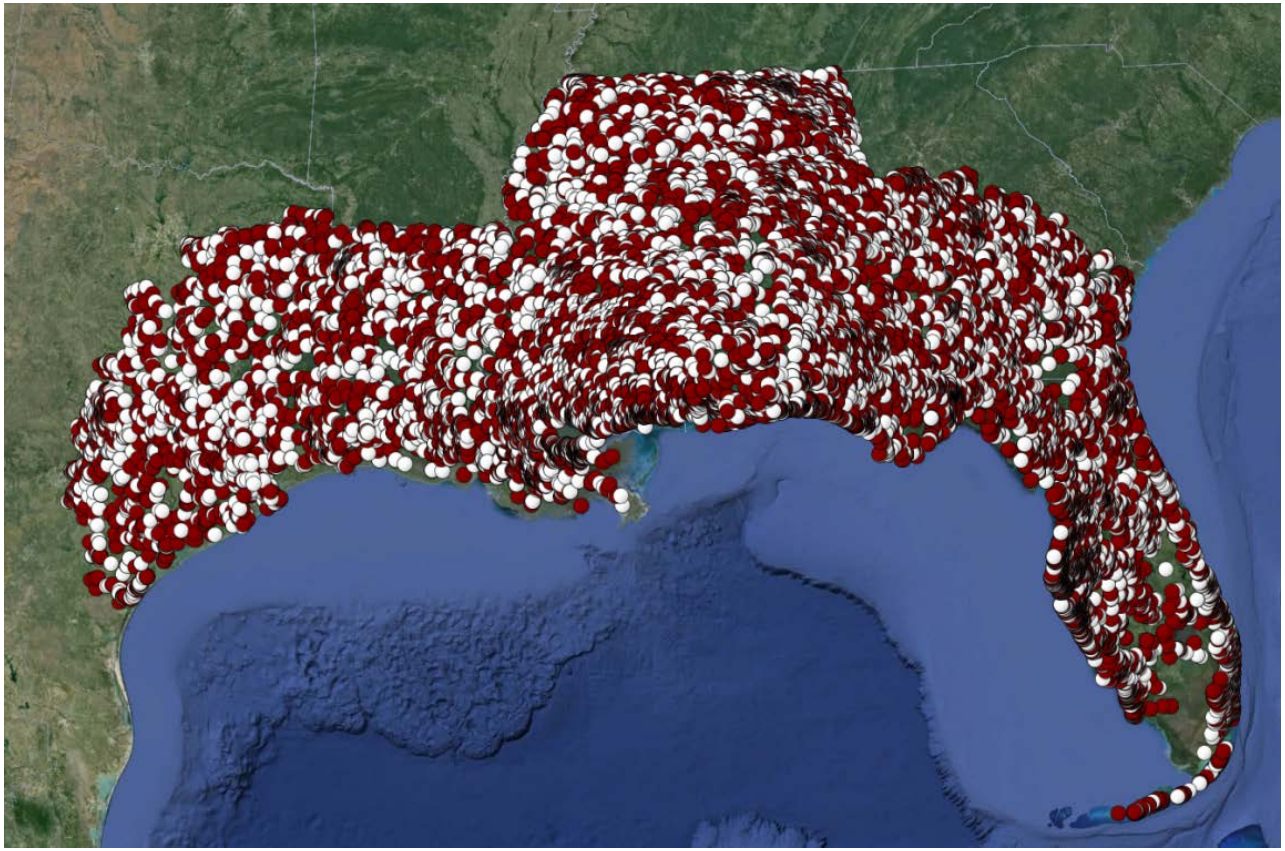
Onsite Counts

Onsite Interviews

Phone Survey

Two Phone Surveys

- **Local** Sample
  - **All** addresses in Louisiana, Mississippi, Alabama and Florida
  - **Parts** of Texas and Georgia
  - **Dual frame**: also drew from boat registration lists

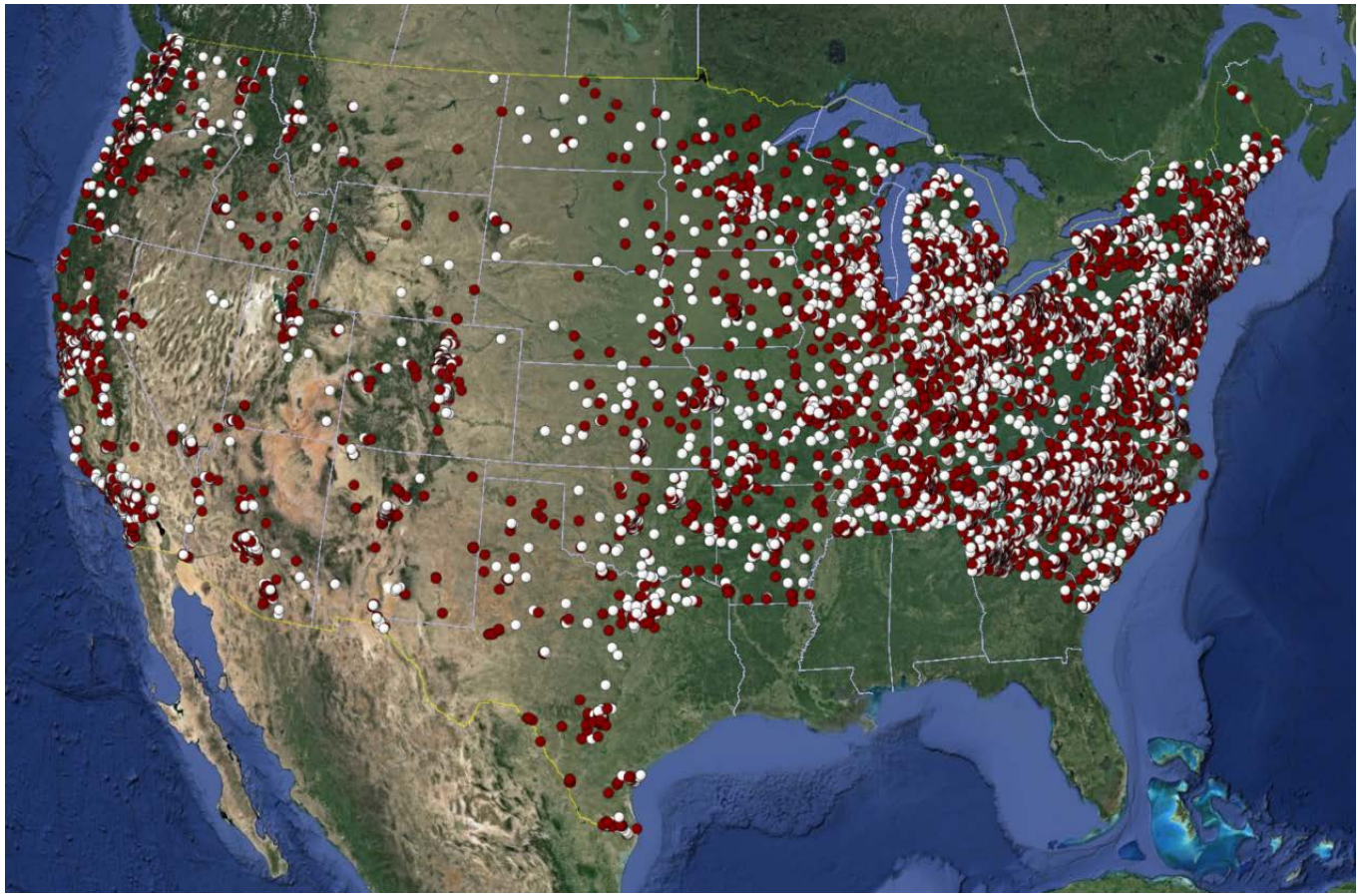


Residences of Local Survey Respondents

Two Phone Surveys

- **National** Sample

  All other residential addresses in contiguous 48 states



Residences of National Survey Respondents

Comparison of Annual User Day Estimates

	Infield Counts / Overflights	Phone Survey
User Days	49 mil	102 mil

Onsite vs. Mail or Telephone Surveys

- In our study, onsite counts resulted in a lower estimate of recreation days than the mail/telephone survey
- Onsite surveys usually result in lower estimates of total trips than mail or telephone surveys

Literature Study	Estimated Ratio of Mail or Telephone Counts to Onsite Counts
Ontario Ministry of Natural Resources (2010)	2.2
National Marine Fisheries Service (2000)	1.3 to 2.7
Environmental Economics Research Group (1998)	2.7
Weithman and Haverland (1991)	1.7 to 2.1

Identification Strategy

Recreational Use Damages = **Lost User Days** × **Value per Lost User Day**

Interim Lost Use Value from shoreline recreation, boating, and fishing

Identified from change in days of recreation under baseline and injury conditions

Data mainly from infield counts and aerial photographs

Estimated from economic demand models of value per day of recreation

Data on visits from national and local telephone surveys

Identification Strategy – This Paper

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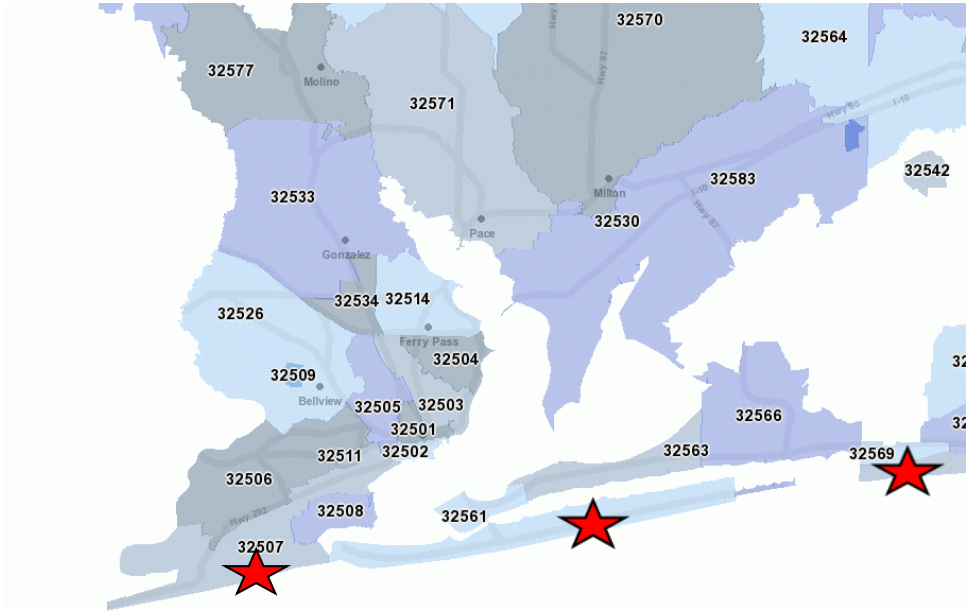
Data: Infield counts

Zonal Travel Cost Approach

- What we observe from the infield counts
  - Zip code origin



- For each zonal origin (i.e., zip code), estimate the number of trips to each site
- Can estimate a travel cost model assuming a representative agent for each zip code origin using Census data

Infield Counts Data

- ~70,000 intercepts
  - 3-year period (2010-2013)
  - At least 16 years old
  - 750 locations
- Sampling weights (important!)
- Trip duration
- Intercept locations aggregated into 53 sites from LA to FL Keys
- Zip code for residence
- Demographics from Census

Key Model Specification Issues

Origins

- 31,000+ zip code origins
    - For each origin, construct trip estimates for each origin/site pair

Travel Cost

- “Expected” Travel Costs for representative agent
    - Weighted average of driving and flying costs
    - Information borrowed from phone survey
        - Mode choice
        - Party size
        - Car rentals
- Repeated discrete choice, nested logit model
- Choice occasions proportional to zip code population

Additional Comparisons

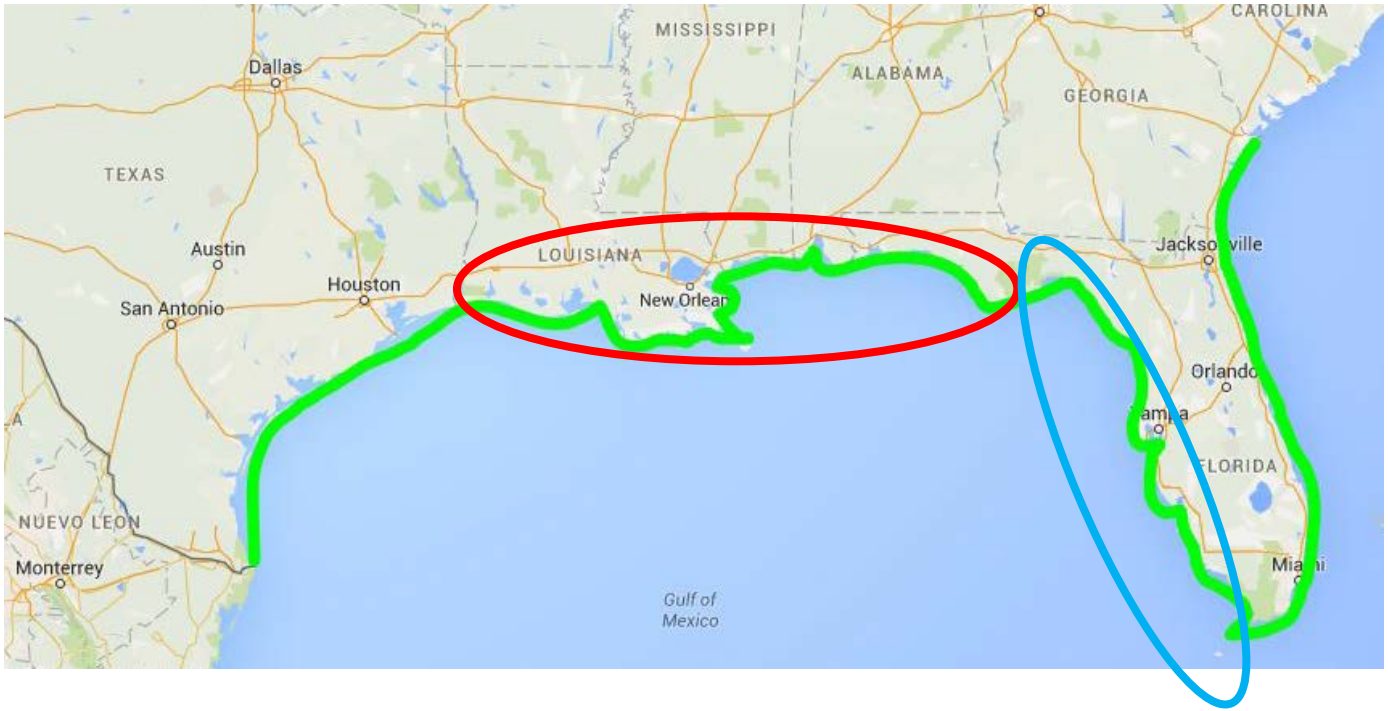
	Infield Counts	Phone Survey
User Days	48 mil	102 mil
Total Days per Trip	2.13	2.37
Recreation Days per Trip	1.68	1.72
% Multi Day Trips	25%	21%
One-Way Driving Distance	196	165

Parameter Estimates

Variable	Estimate	t-stat
Travel cost/100	-1.659***	-33.06
Dissimilarity coefficient	0.471***	19.56
No-trip constant interacted with:		
$25k < Income ≤ $50k	-2.128***	-5.496
$50k < Income ≤ $75k	-2.502***	-6.346
$75k < Income ≤ $100k	-2.647***	-6.360
$100k < Income ≤ $150k	-2.968***	-7.228
$150k < Income	-4.023***	-8.524
Distance Control - Texas	-0.663***	-7.206
Distance Control - Atlantic Florida / Georgia	-2.958***	-23.17
Age	-8.761**	-2.887
Age^2	6.369*	1.903
High school diploma	3.998***	5.987
College degree	0.571	0.807
Unemployed	-1.018	-0.986
White	-1.648***	-7.244
Male	-1.864**	-2.268
HH members < 18	0.639	0.702
HH size	1.959	0.689
Observations	31,705	

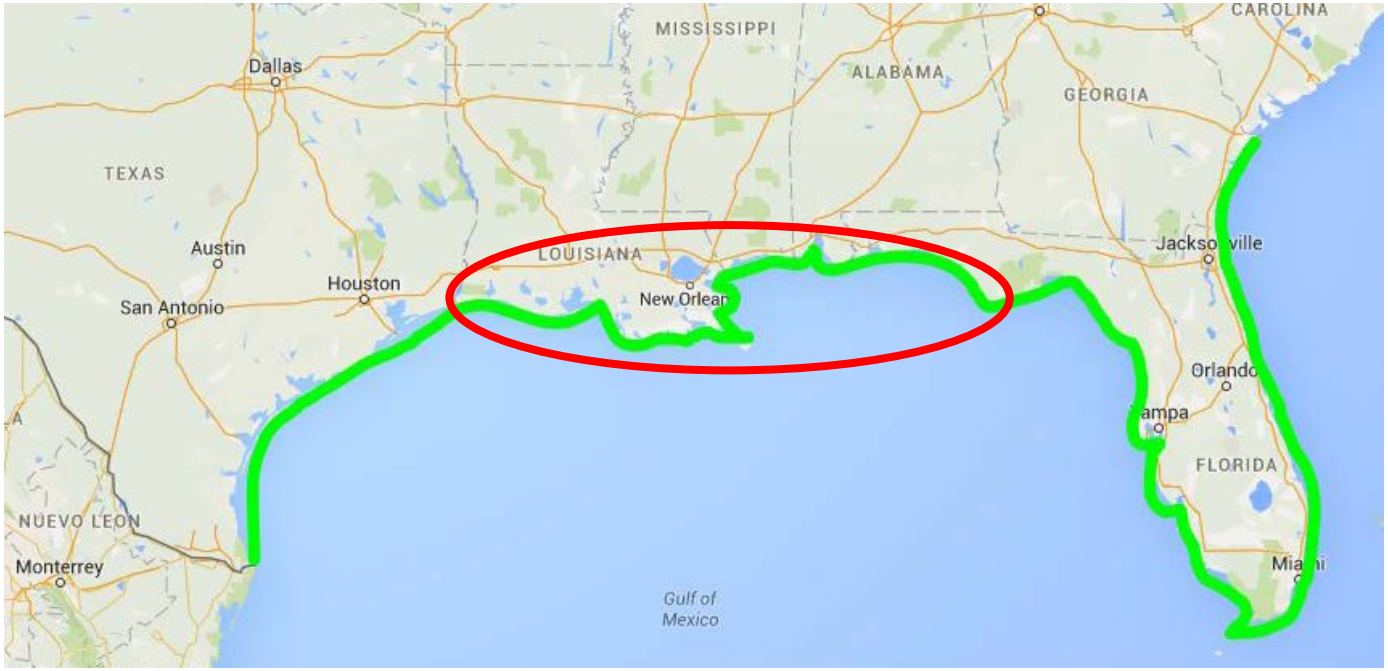
Spill Scenarios

- Introduce site constant adjustments to be consistent with:
  - Scenario #1 (June 2010 - January 2011):
    - **North Gulf**: 45.2% reduction in trips
    - **Peninsula**: 22.2% reduction in trips



Spill Scenarios

- Introduce site constant adjustments to be consistent with:
  - Scenario #2 (February 2011 – November 2011):
    - **North Gulf**: 10.0% reduction in trips



User Day Damage Estimates

Scenario	Infield Counts	Phone Survey
#1	$39.58	$35.80
#2	$35.22	$38.86

Concluding Thoughts

- Results are robust to a number of sensitivity checks
- We propose an alternative strategy for using onsite counts that obviates many shortcomings of existing approaches
- Broader implications for how to collect and analyze data for infrequently purchased goods
- Questions or comments? roger_von_haefen@ncsu.edu