Economic valuation of losses to sport fishers from the DWH Spill

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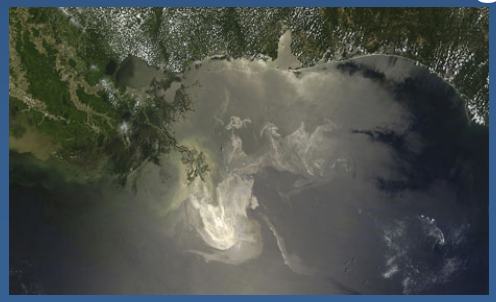
Research Plan

Questions:

- Did the DWH spill affect the demand for marine recreational fishing in the American Southeast?
- If so, what was the loss to angler welfare?



Objective:

- Develop a revealed preference model to measure shifts in demand for recreational fishing (and hence welfare impacts) as a result of the DWH oil spill

Hypothesis Test:

Ho: DWH had no impact on recreational fishing in the SE

Ha: DWH had a significant negative impact on recreational fishing in the SE

Contribution

- Early economic assessments of non-market damages from oil spills relied on *benefit transfer methods* (Grigalunas et al. 1986; Mazzota et al. 1994)

- The recent literature has focused on *stated preference methods* to value the impacts of oil spills (e.g., Carson et al. 2003, 2004; Van Biervliet 2005; Loureiro et al. 2009; Loureiro and Loomis 2010)

- *Revealed preference methods* have relied on retrospective recreational behavior and have used very coarse measure of oil spill impacts (Hausman et al. 1995)

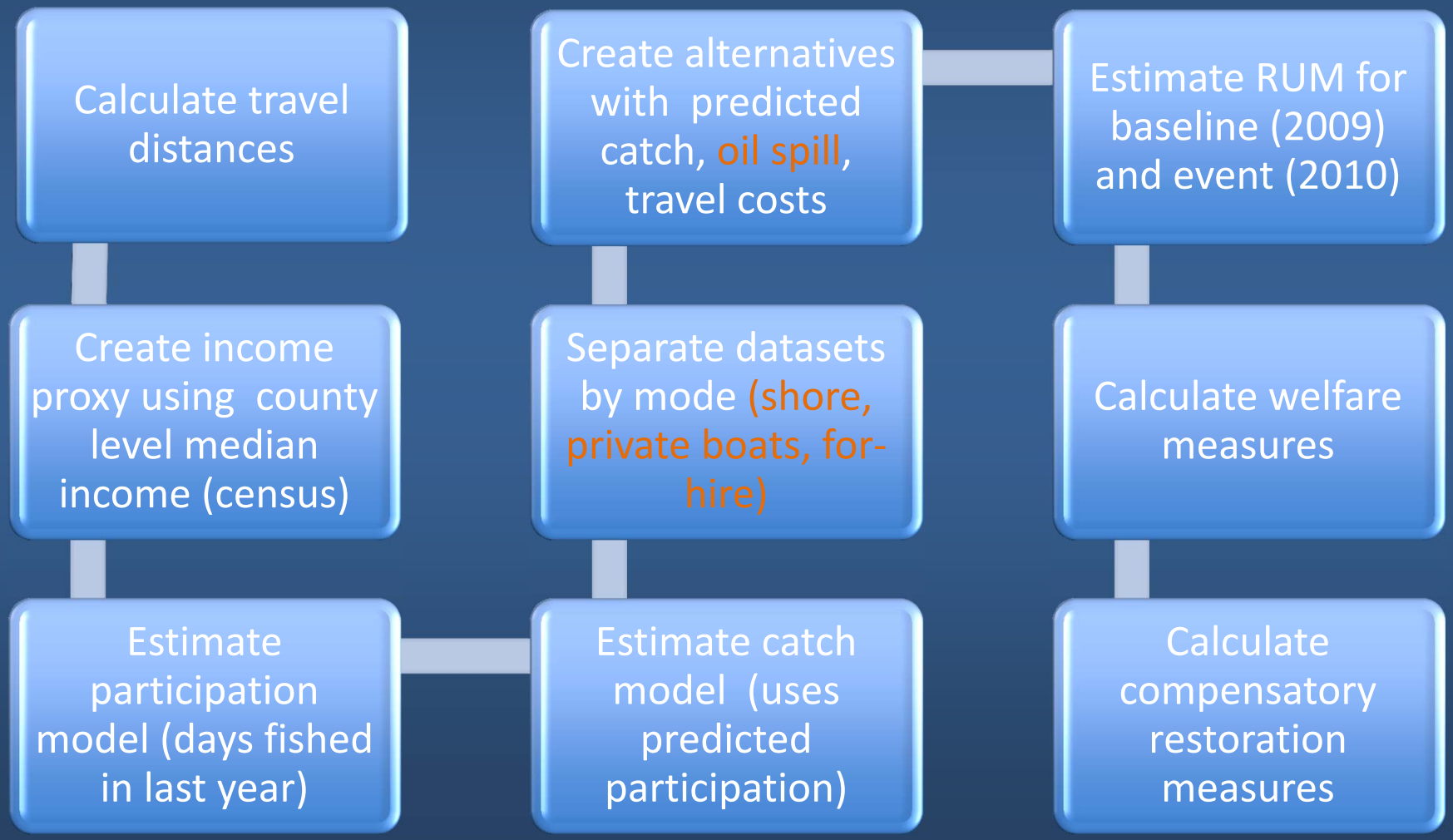
We use continuously collected intercepts and a measure of oil spill impacts that is explicit in both space and time

Marine Recreational Information Program (MRIP) Data

- 2006-2010
- Annual, access-point creel survey conducted by the NMFS
- Conducted by two month periods referred to as *waves*
- For each fishing trip MRIP documents county of origin and destination, catch, fishing mode, fishing area, time spent fishing, species, fish size/weight
- Approx. 70,000 annual intercepts in the Southeastern US
- Modeling Issue: no demographic, socio-economic information collected ("economic add-on" for select years, not 2010)

The Model

Quick Walkthrough



1st Stage

Count data model of catch for all species

$$Ln(C_{nj}) = \delta_0 + \delta_1 P_n + \delta_2 L_j + \delta_3 T_{nj} + \eta_{nj}$$

: Angler *n* attributes (*experience, income, mode*)

Site-season *j* attributes (*historic catch, popularity, access, gulf*)

: Trip attributes of *n* to *j* (*length, target, area*)

$_j$ is an attribute that varies by angler and location

2nd Stage

Angler Choice

gler *n* chooses alternative *j* (site-season) if it yields higher utility:

$$U_{nj} > U_{nh} \qquad \forall h \neq j$$

ility has a deterministic (V_{nj}) and a random (ε_{nj}) component:

$$U_{nj} = V_{nj} + \varepsilon_{nj}$$

$$U_{nj} = \alpha TC_{nj} + \beta_1 Ln(\widehat{C_{nj}}) + \beta_2 spill_j + \beta_3 L_j + \beta_4 E_j + \varepsilon_{nj}$$

TC_{nj} : Travel costs

spill : Dummy variable (1 if oil present, 0 otherwise)

L_j : Location (*10 regions in SE U.S.*)

E_j : Season (*spring, summer, fall*)

o utility functions corresponding to two states of the world

oil spill happened (actual):

$$U_{nj} = \alpha TC_{nj} + \beta spill_j + \varepsilon_{nj}$$

No oil spill because anglers pay to prevent it (i.e., counterfactual):

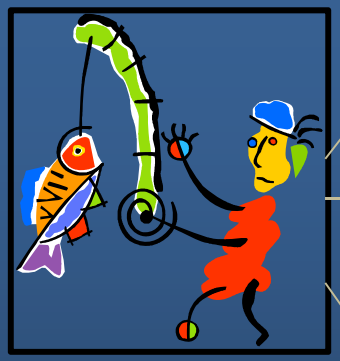
$$U_{nj}^{*} = \alpha(TC_{nj} + WTP_n) + \beta(spill_j - \Delta spill_j) + \varepsilon_{nj}$$

find compensation required, equate $U_{nj} = U_{nj}^{*}$ and solve WTP:

$$WTP = \frac{1}{\alpha}\beta \cdot \Delta spill_j$$

Graphic interpretation of choice model

Angler wants to go fishing



When?

Season 1

Season 2

Season k

Where?

Site 1
Site 2
Site j

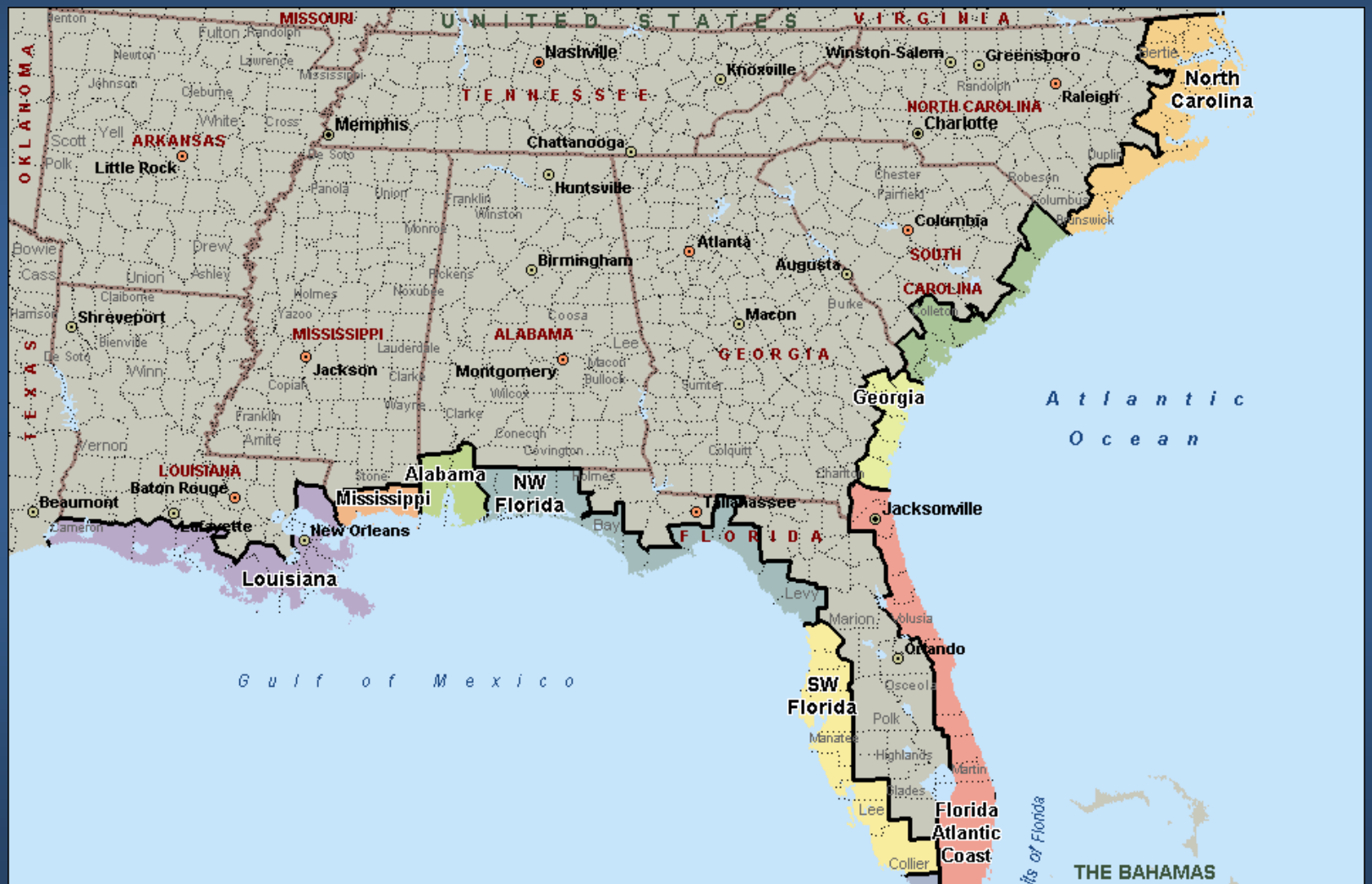
Site 1
Site 2
Site j

Site 1
Site 2
Site j

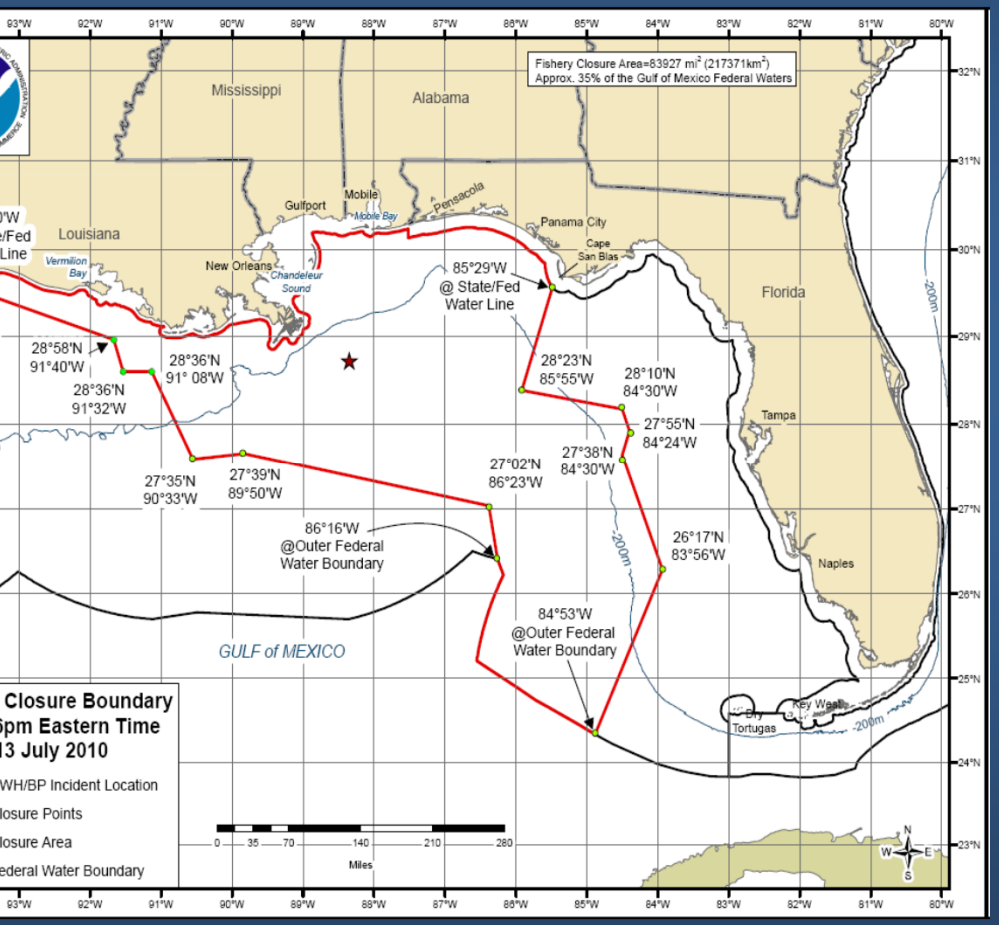
Attributes vary across choice set

Model specification

Definition of fishing sites



DWH Oil Spill



Timeline of oil expansion from NOAA fishery closure maps

If closure up to state line, region deemed to be impacted (*spill* = 1)

Specific to site and season

Predicted Catch Model

Segregate by mode

Create alternatives and attributes

Site Choice Models (conditional and mixed logit)

Three modes:

Shore

For hire (charter, head/party boats)

Private and Rental Boats

Results

Catch Model

Variable	Coef.	St. Error	Z
targ	**0.437**	0.027	16.17
mode1	**-0.162**	0.034	-4.72
mode2	**0.176**	0.055	3.18
area1	**0.143**	0.032	4.51
area2	**0.505**	0.047	10.83
hrsf	**0.207**	0.007	28.17
hckr	**3.185**	0.125	25.4
ffdays12	**0.002**	0.0003	8.38
popularity	-0.0005	0.0003	-1.85
med_income	**-0.0001**	0.000	-6.6
constant	-2.075	0.086	-24.13

Model Statistics:

Log-Likelihood = 4443.53

Site Choice Models

omparison across fishing modes by attributes

Travel Costs (*TC*)

	Conditional Logit			Mixed Logit		
	Shore	For-hire	Private	Shore	For-hire	Private
	-0.0096	**-0.0034**	**-0.0140**	**-0.0260**	**-0.0073**	**-0.0383**
r	0.00009	0.00004	0.0001	0.0005	0.0002	0.0006
	-105.63	-78.89	-139.24	-48.09	-47.16	-61.53
f.)				**0.0140**	**0.0079**	**0.0193**
r (SD)				0.00034	0.0002	0.0004
				40.12	39.6	50.63

Interpreted as the marginal utility of income

Private and rental boat anglers most responsive to TC; for-hire anglers least responsive to TC

Preferences for TC heterogeneous across fishing modes

DWH Spill (*spill*)

	Conditional Logit			Mixed Logit		
	Shore	For-hire	Private	Shore	For-hire	Private
	-0.6306	**-0.4289**	**-0.1391**	**-0.7227**	**-0.2528**	**-0.0636**
r	0.0356	0.0350	0.0245	0.0550	0.0367	0.0317
	-17.74	-12.43	-5.67	-13.26	-6.9	-2.01
f.)				**1.1820**	0.2197	**1.3786**
r (SD)				0.1317	0.1355	0.0838
				8.97	0.16	16.45

Average angler in all modes is averse to oil spill

Private anglers least averse to areas affected by oil

Shore and private boat angler preferences towards the oil spill are

Gulf of Mexico (*gulf*)

	Conditional Logit			Mixed Logit		
	Shore	For-hire	Private	Shore	For-hire	Private
	1.2025	**0.8255**	**1.5871**	**1.8459**	**0.9162**	**2.4053**
r	0.0296	0.0250	0.0254	0.0600	0.0333	0.0500
	40.68	33.02	62.54	30.77	27.48	48.12
f.)				0.0087	0.0145	0.0287
r (SD)				0.0625	0.0985	0.0429
				0.14	0.15	0.67

Average angler prefers locations in the Gulf of Mexico over the Atlantic Coast

Preferences for the Gulf are homogeneous

Welfare Estimates

Per trip welfare losses ($/trip)

$$WTP = \frac{1}{\alpha}\beta \cdot \Delta spill_j$$

Mode	Conditional Logit			Mixed Logit		
	Mean	95% CI		Mean	95% CI	
hore	$65.57	$57.99	$73.05	$27.76	$23.53	$32.14
or Hire	$125.63	$104.54	$146.15	$34.53	$24.22	$44.96
rivate	$9.95	$6.40	$13.47	$1.64	$0.01	$3.31

eans and CI's obtained using Krinsky-Robb simulations

Total welfare losses ($mil)

WTP*trips

lode	Conditional Logit			Mixed Logit		
	Mean	95% CI		Mean	95% CI	
nore	$1,112.50	$983.90	$1,239.50	**$471.00**	$399.20	$545.30
or Hire	$119.10	$99.10	$138.60	**$32.70**	$22.90	$42.60
ivate	$220.90	$142.10	$299.00	**$36.40**	$0.20	$73.40
OTAL	**$1,451.36**	**$1,296.99**	**$1,601.65**	**$542.25**	**$459.93**	**$625.39**

eans and CI's obtained using Krinsky-Robb simulations

Conclusions

Reject null hypothesis of no impact on recreational fishing demand

Compensable damages: $542 million

Spill seen as a ‘bad’ with negative influence on fishing choice

Preferences for TC, oil spill, and number of access points are heterogeneous

Our model allows estimation of non-market losses from events that lower environmental quality using revealed preferences without hypothetical site closures

Questions?

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