Ignoring the Multi-species Aspect of Labor Supply Decisions in Spatial Bio-economic Fishery Models

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Main Question:

- How does incorporating the multi-species aspect that characterizes some fisheries affect policy predictions of bio-economic fishery models?

Questions to address

1) Where does this study fit into the literature?
2) How do I model fishing behavior?
3) What do I find?

1. Where does this study fit in?
Emerging literature

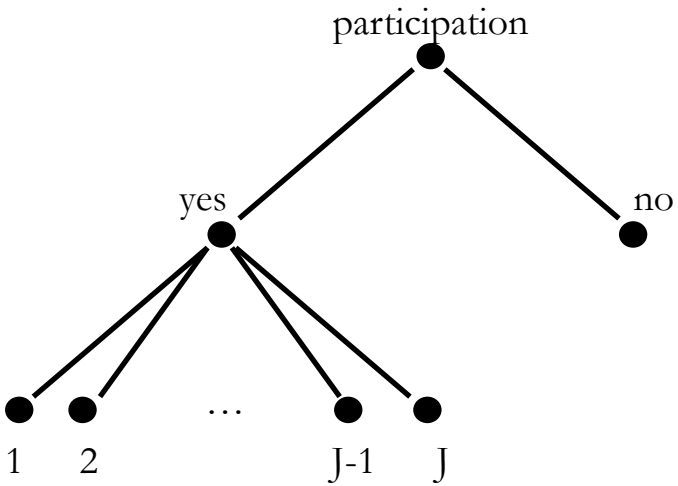
- Typical management models are bio-based & assume fishing effort is exogenous
- Emerging literature endogenizes fishing effort[1]

[1] See, e.g., Smith and Wilen (2003), Kahui and Alexander (2008), Smith (2008)

1. Where does this study fit in?

Emerging literature

Nested Choice Structure:



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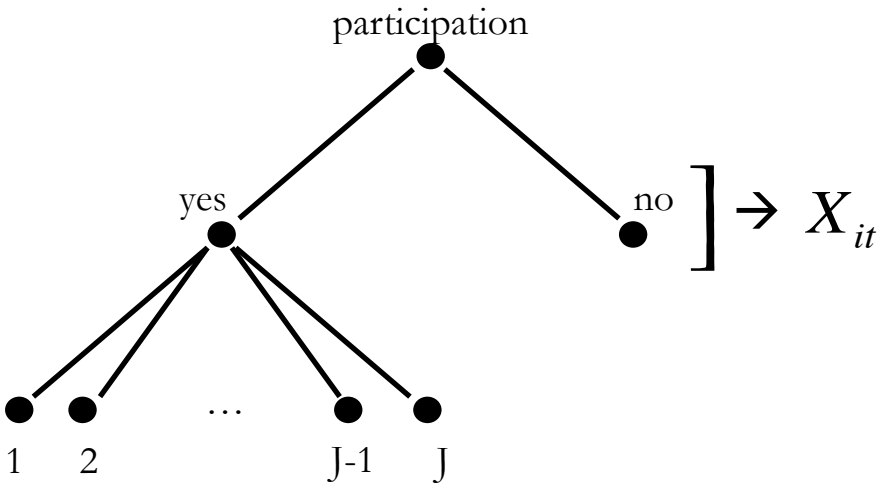

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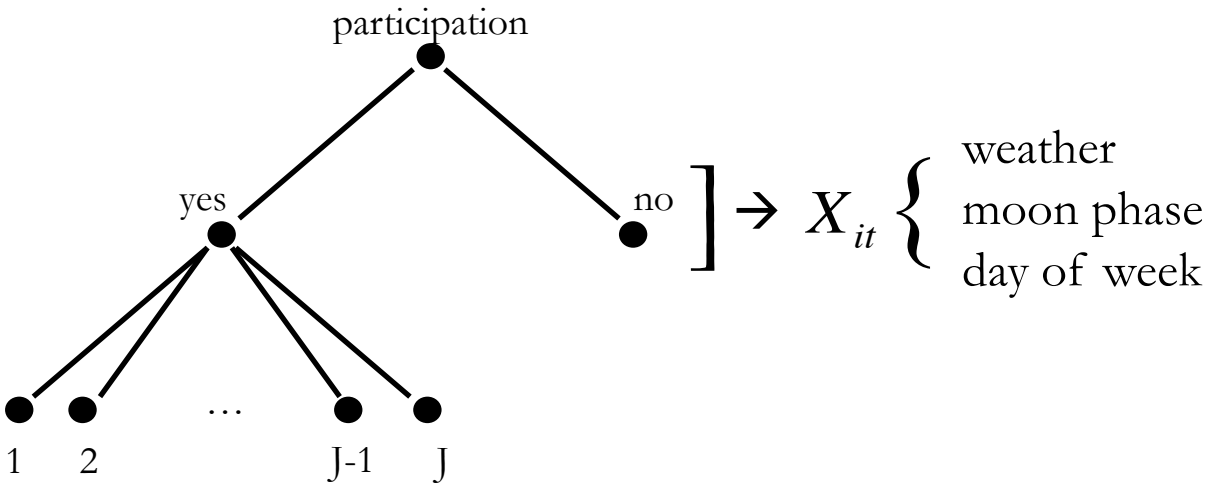

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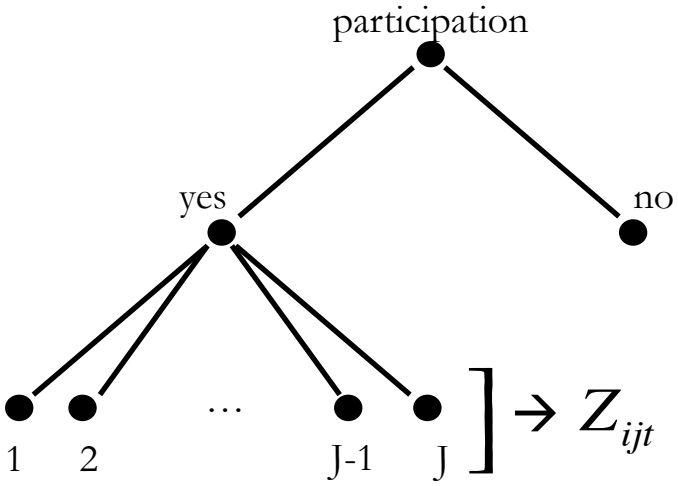

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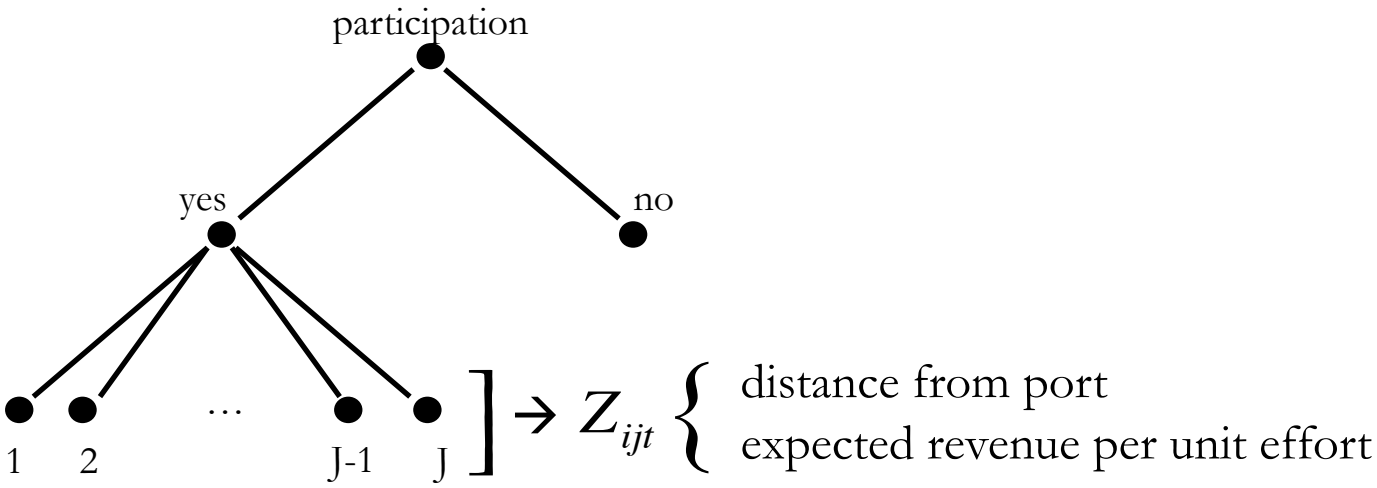
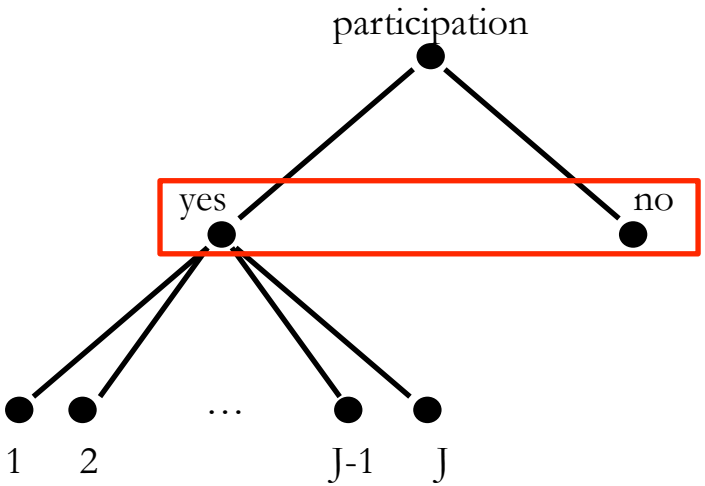


1. Where does this study fit in?

Caveat of emerging literature

Nested Choice Structure:

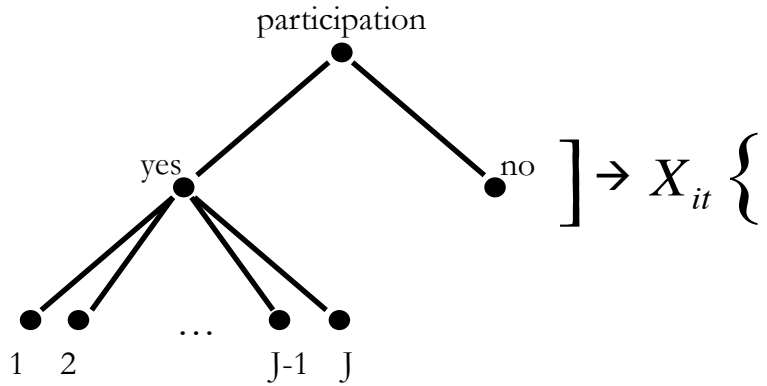


2. How do I model fishing behavior?

My contribution

Two Alternatives:

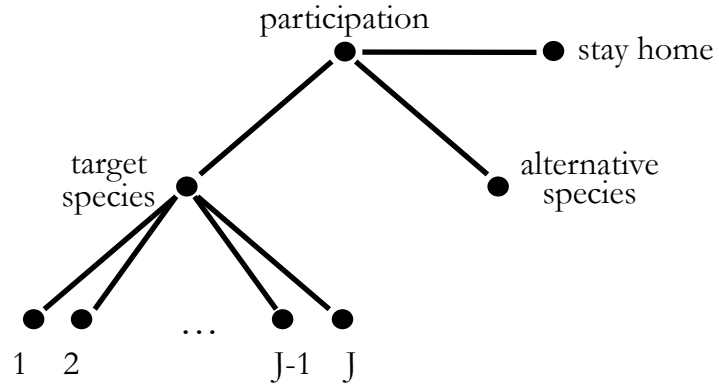
1)



$\rightarrow X_{it}$

weather
moon phase
day of week
variables that describe profitability of alternative species

2)



2. How do I model fishing behavior?
My contribution

- Target Species = Florida Lobster
- Alternative Species = Stone Crab
- Estimate the 3 models using the same sample
- Derive and compare predicted participation rates out of sample
- Derive and compare predicted participation rates for various management policies

2. How do I model fishing behavior?

Random Utility Model

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} \qquad for\ j = 1, 2, \ldots, m$$

$$where \qquad V_{ijt} = f\left(X_{it}, Z_{i1t}, Z_{i2t}, \ldots, Z_{iMt}; \theta\right)$$

i subscripts fishermen
j subscripts location
t subscripts date

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Location-constant (e.g. day of week)

Location-specific (e.g. distance from port, expected catch)

i subscripts fishermen
j subscripts location
t subscripts date

2. How do I model fishing behavior?
Nested Logit Model

- From the RUM & the assumption that the errors are *i.i.d.* generalized extreme value, we derive the nested logit probabilities:

$$\Pr(go\ to\ j) = g(X_{it}, Z_{ijt}; \theta, \sigma) \quad \forall j$$

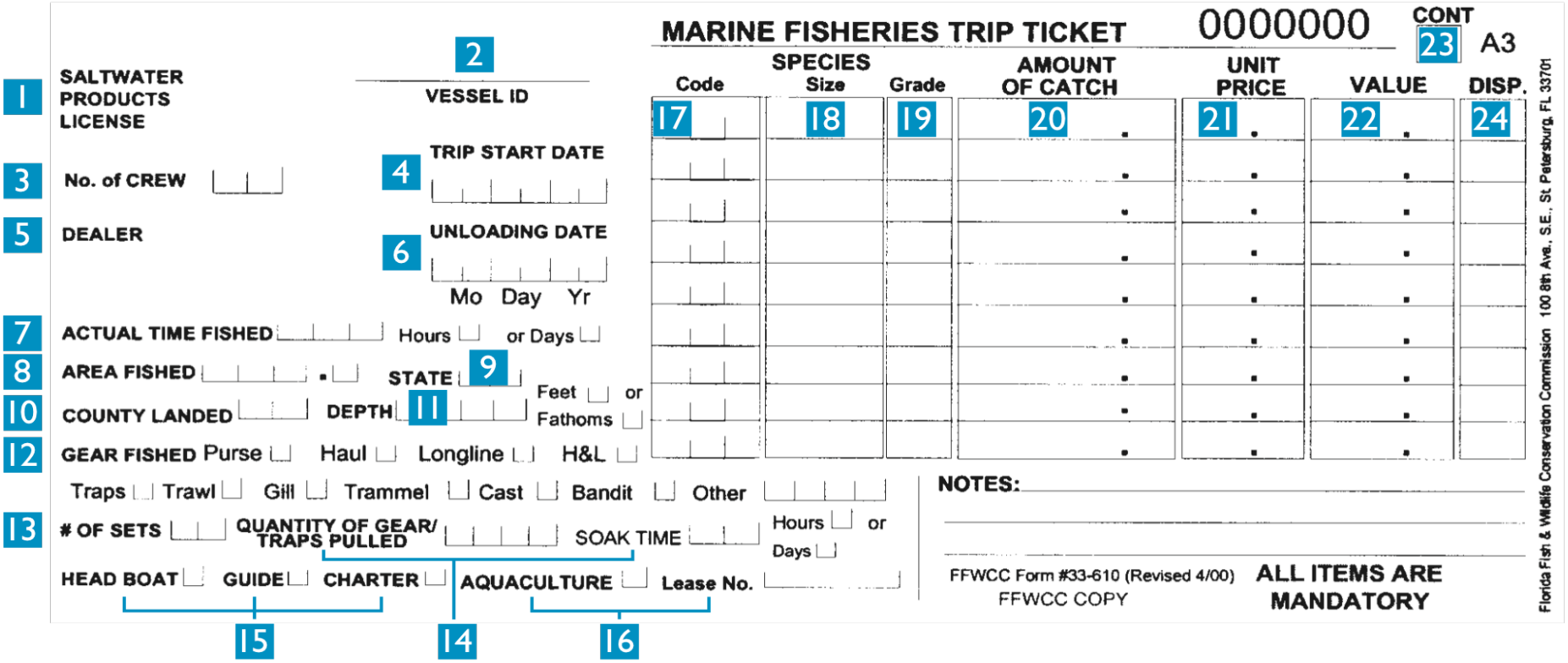
$$\Pr(do\ not\ go) = 1 - \sum_{j=1}^{m} \Pr(go\ to\ j)$$

2. How do I model fishing behavior? Explanatory Variables

- Participation-specific (**X**)
  - Wind speed, current
  - Wind speed, 2 day lag
  - Moon cycle
  - Sunday
  - Stone crab permit
  - Stone crab season
  - Stone crab revenue
- Location-specific (**Z**)
  - Distance
  - Revenue per unit effort

2. How do I model fishing behavior?

Data: Main Source



3. What do I find?

Marginal effects, participation

Variable	Model 1	Model 2	Model 3
Lobster Participation			
Wind Speed	-0.01962	-0.01736	-0.01736
Lagged Wind Speed	0.00138	0.00389	0.00386
% Full Moon	-0.00765	-0.00907	-0.00923
Sunday	-0.06469	-0.06403	-0.06381
Stone Crab Permit	-	0.04407	0.04578
Stone Crab Season	-	-0.02795	-0.02929
Stone Crab Revenue	-	0.00277	0.00318
Stone Crab Participation			
Wind Speed	-	-	-0.00451
Lagged Wind Speed	-	-	0.00139
% Full Moon	-	-	0.00118
Sunday	-	-	-0.01866
Stone Crab Permit	-	-	-0.00084
Stone Crab Season	-	-	0.01044
Stone Crab Revenue	-	-	0.00681

3. What do I find?

Marginal effects, location

Variable		Model 1	Model 2	Model 3
Location-Specific				
Distance	Neither	0.00082	0.00055	0.00041
	Area 1	-0.00143	-0.00135	-0.00132
	Area 2	0.00012	0.00018	0.00020
	Area 3	0.00004	0.00005	0.00005
	Area 4	0.00006	0.00008	0.00008
	Area 5	0.00038	0.00050	0.00055
	Stone Crab	-	-	0.00002
Revenue	Neither	-0.00364	-0.00164	-0.00099
	Area 1	0.00633	0.00405	0.00315
	Area 2	-0.00055	-0.00053	-0.00047
	Area 3	-0.00016	-0.00015	-0.00013
	Area 4	-0.00029	-0.00023	-0.00019
	Area 5	-0.00169	-0.00151	-0.00132
	Stone Crab	-	-	-0.00005

3. What do I find?

Implementation of 5% landings tax

	Model 1		Model 2		Model 3	
Choice	Pre	Post	Pre	Post	Pre	Post
Non-Lobster	59,215	59,626	59,714	59,957	59,833	59,996
		0.69%		0.41%		0.27%
Stone Crab	-	-	-	-	3,604	3,564
		-		-		-1.10%
Area 1	3,136	3,029	3,003	2,938	2,993	2,949
		-3.43%		-2.16%		-1.49%
Area 2	1,174	1,105	1,120	1,075	1,104	1,070
		-5.90%		-4.00%		-3.02%
Area 3	324	313	312	305	313	308
		-3.47%		-2.20%		-1.51%
Area 4	3,201	3,069	3,033	2,953	2,941	2,886
		-4.12%		-2.64%		-1.88%
Area 5	4,587	4,496	4,456	4,409	4,454	4,429
		-1.99%		-1.05%		-0.57%

3. What do I find?

Close Area 2

	Model 1		Model 2		Model 3	
Choice	Pre	Post	Pre	Post	Pre	Post
Non-Lobster	59,215	60,316	59,714	60,482	59,833	60,437
		1.86%		1.29%		1.01%
Stone Crab	-	-	-	-	3,604	3,592
		-		-		-0.32%
Area 1	3,136	3,271	3,003	3,267	2,993	3,329
		4.30%		8.80%		11.24%
Area 2	1,174	0	1,120	0	1,104	0
		-100.00%		-100.00%		-100.00%
Area 3	324	336	312	336	313	344
		3.68%		7.82%		10.05%
Area 4	3,201	3,094	3,033	2,981	2,941	2,915
		-3.36%		-1.73%		-0.90%
Area 5	4,587	4,621	4,456	4,571	4,454	4,613
		0.73%		2.58%		3.56%

4. Main Results

- Model 1 predicts a stronger participation response to a 5% landings tax & closure of Area 2 than Models 2 or 3
- At the least, mgmt models should include covariates describing opportunities in other fisheries