Summer Flounder Quota Allocation Analysis

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Recreational Analysis

Study Outline

Goal of Recreational Component:

Measure the benefits (or costs) to recreational anglers from a change in the summer flounder quota.

Key Steps:

- Develop a model of individual angler behavior
- Develop a measure of the costs or benefits from quota changes
- Aggregate results to population
- Using aggregate results, develop marginal analysis for allocation recommendations
- Recognize limitations of model

What is the data telling us about Summer Flounder?

1. Focus on NC to MA
2. Drop waves 1 (Jan-Feb) and 6 (Nov-Dec)
3. Summer Flounder is heavily caught and targeted
4. Even non-targeted trips might catch summer flounder

Details

The Econometric Model

Our work follows previous work by McConnell and Strand, and Hicks et al.

Key Insight:

The summary data suggests that even those not directly targeting SF may catch SF and therefore, we need a model that allows trip values to be influenced by a broad range of species.

The Econometric Model: Choice Structure

Choice structure:

- We model the choice of mode [shore, private/rental, party/charter], species group [small game, bottom fish, summer flounder][1], and fishing site (at the county level).
- **80 x 3 x 3** potential choice alternatives per observed trip in the data.
- We have approximately 30,000 trips (in NC-MA in 2014) $\times$ 720 choice alternatives $=$ 21.6 million rows of data for modeling!

[1] Other species groups such as big game, other flat-fish, non-specific targets are ommitted from our analysis.

McConnell/Strand Species Groupings

Small Game		
Striped Bass	Bluefish	Jack
Pompano	Seatrout	Bonefish
Bonito	Snook	Red Drum
Barracuda	Mackerel	
Bottom Fish		
Sandbar Shark	Dogfish Shark	Cat Shark
Sand Tiger Shark	Smooth Dog Shark	Carp
Catfish	Toadfish	Cod/Codfish
Pollack	Hake	Sea Robin
Sea Bass	Sawfish	Grunt
Kingfish	Mullett	Tautog
Butterfish	Nurse Shark	Brown Cat Shark
Porgy/Scup	Sheepshead	Pinfish
Snapper	Grouper	Perch
Black Drum		
Flat Fish		
Summer Flounder	Winter Flounder	Southern Flounder
Sole	Founders	
Big Game		
Blue Shark	Tuna	Marlin
Thresher Shark	Great Hammerhead	Swordfish
Shortfin Mako Shark	Tiger Shark	White Shark
Smooth Hammerhead	Scalloped Hammer	Tarpon
Billfish	Sailfish	Dolphin
Cobia	Wahoo	
Other Fish		
Herring	Eel	Skate
Puffer	Blacktip Shark	Requiem Shark
Dusky Shark	Atlantic Sharpnose	Bull Shark
Smalltail Shark		

The Econometric Model: Choice Structure Reduction

Reducing size of Choice Structure

Using the NOAA Fisheries S&T distance files, we limit the choice structure to those sites within 150 miles of the respondents home.

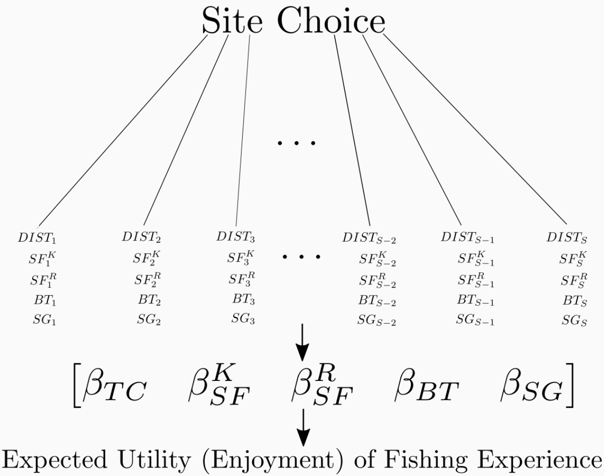
Note: This necessarily eliminates all persons in the MRIP sample living far away (>150 miles) from their chosen site.

The Econometric Model: Expected Catch, Release, and Keep

Correcting for MRIPS Sampling Intensity

Since strata are over (under) sampled in MRIPS, we use the supplied sample weights for calculating **any** summary statistic (e.g. average per site catch for summer flounder) in this study.

RUM Choice Model for Recreation Demand



Model Details   Result Details

Policy Analysis: CV for Keep versus Release of SF

For our purposes, all $\mathbf{x}$'s will remain as observed in the data, except for landings and released historical catch averages for summer flounder. Note that the allocation policy

- Doesn't alter total catch (combined keep and release)
- Does alter the distribution of total catch between keep and release categories.

Example: a +10% Increase in Summer Flounder Allocations to the Recreational Sector

Table 1: Example Policy Impacts on Catch and Keep Rates

Policy	Total Catch	Landings	Release
0	5	3	2
1	5	3.3	1.7

Details

Policy Analysis: Compensating Variation

The standard welfare calculation for angler i at time t (defined as compensating variation (CV)) for a change in policy affecting site-specific variables from $\mathbf{x}$ by altering recreational allocation and hence site specific summer flounder catch rates is defined as:

$$CV_{it}(\Delta) = \frac{log\left(\sum_{i \in S} e^{\mathbf{x}^0_{ist}\beta}\right) - log\left(\sum_{i \in S} e^{\mathbf{x}^1_{ist}\beta}\right)}{\beta_{tc}}$$

For total willingness to pay (across the population), we calculate the sample weighted average compensating variation ($\overline{CV}$) and multiply times total number of trips.

Marginal Willingness to Pay Recreational Sector (Time Cost Excluded)

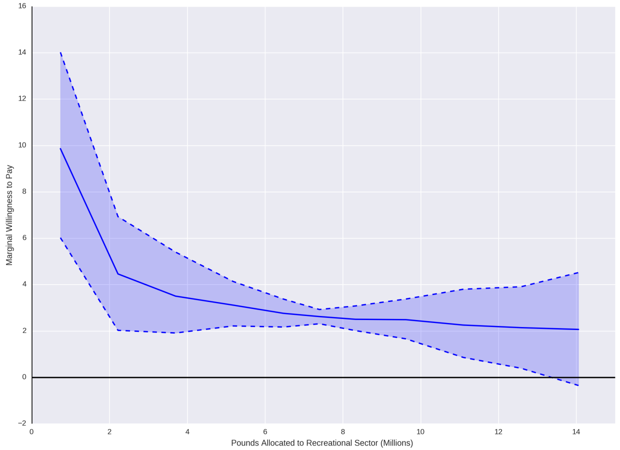
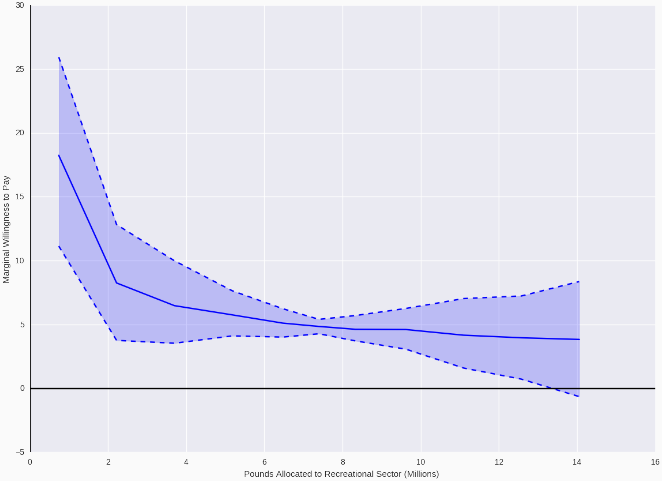


Table 2: A comparison of Summer Flounder Marginal Willingness to Pay Estimates

Study	Mean Value per Pound	Opportunity Cost of Time	Weighting	Nested
Current Study	\$9.86 - \$2.07	Not Included	Yes	No
Gentner et al.	\$3.48	Included	No	Yes
	\$2.38	Not Included	No	Yes
	\$1.45	Included	No	No
	\$0.80	Not Included	No	No
	\$0.99	Included	Yes	No
	\$0.53	Not Included	Yes	No
Massey et al.	\$1.59	Unknown	Unknown	No

Policy Simulations: Marginal Willingness to Pay [Preferred Model]



Recreational Model Caveats

- Uses historical data on recreational catch (2010-2014) to characterize current conditions in the fishery.
- Due to data limitations, ignore changes in trips that might occur due to quota changes
- Ignore losses/gains in profits at charter operations, bait shops, and boating repair and supply businesses.
- Due to data limitations (no economic add-on), preferred estimate of MWTP uses benefits transfer methods.

Commercial Analysis

Overview

- Our analysis differs from the prior work on sector allocation (Gentner et al. 2010; Carter et al. 2008)
- Our analysis uses the Random Utility Model (McFadden 1978) framework
- We use the model as a predictive model of commercial fishermen behavior

Model Overview

Steps:

1. Estimate trip-level costs
2. Estimate a site choice model for commercial fishermen
3. Combine (1) and (2) into a fleet simulation
4. Use (1) - (3) to estimate marginal values per a pound

Step 1: Estimating Trip Level Costs - Outline

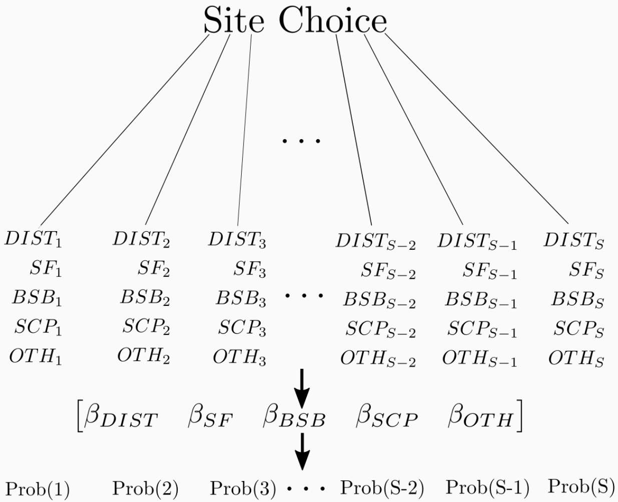
- We use trip-level cost data from 2000 through 2014
- Data was obtained from the Social Science Branch of the NMFS Northeast Fisheries Science Center
- Part of the annual data collection of the Northeast Fishery Observer Program (NEFOP)
- We focus only those vessels who landed summer flounder
- Estimate a log-log trip level cost function

Trip Cost Estimation Results

Step 2: Modeling Discrete Choices

- Modeling builds on an extensive literature of spatial choice modeling in fisheries (Curtis and Hicks 2000); (Hicks and Schnier 2008); (Haynie et al. 2009); (Holland and Sutinen 1999,2000); (Smith and Wilen 2003)
- Based on the estimation of a random utility model (RUM) (McFadden 1978). Same model used in recreational section.
- We incorporate alternative specific constants (Timmins and Murdock 2007); (Smith 2005); (Hicks et al. 2012)
- Use 60-day lags to calculate the variables
- 2,337 unique trips between 2000-2014 and 20,900 unique hauls

The Commercial Choice Model



Model Details Model Results

Step 3: Policy Simulation

The simulation model uses the parameter estimates from Steps (1) and (2) to simulate fleet behavior

- Step 1: Initialize the TAC in the commercial sector (1,000 metric ton increment up to 24,000 metric tons)
- Step 2: Take a random draw from the parameter distribution
- Step 3: Randomly draw fishing trip from data and calculate probabilities:

$$P(i,t) = \frac{e^{U(i,t)}}{\sum_{j \in N} e^{U(j,t)}}$$

  and multiply the probability by the expected catch rates and calculate expected catch for each species. E.g. summer flounder:

$$E[Catch_{SF,t}] = \sum_{j \in N} P(j,t) * SFExp_{j,t}$$

Step 3: Policy Simulation, cont.

- Step 4: Reduce the TAC's by the expected catch
- Step 5: Calculate the expected profits from each trip

$$\sum_{i \in N} P(i,t)[SFRev_{i,t} + BSBRev_{i,t} + SCUPRev_{i,t} + OtherRev_{i,t} - TripCosts_{i,t}] \quad (1)$$

- Step 6: Determine if the current catch exceeds the allocation and if TAC not exceeded return to step 2
- We increase commercial TAC up by 1,000 and then re-run and store results

Simulation Models

- Model 1: Base model
- Model 2: Base model plus state allocations. We remove vessels from states that have exceeded their state allocations
- Model 3: Base Model + Seasonal fishing patterns. We randomly draw a vessel trip from the distribution to mirror the seasonal distribution. Preferred Model

Details

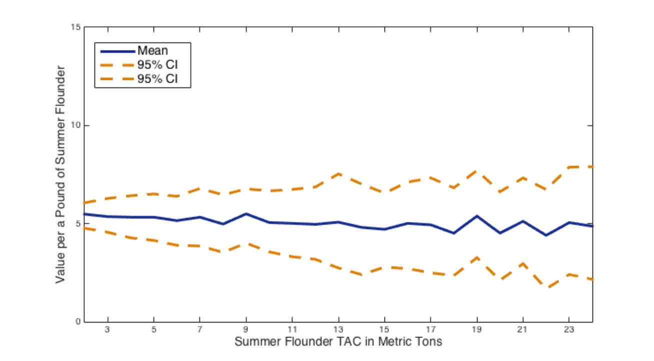
Marginal Values

- Construction of Marginal Values:

$$\text{Marginal Value}_k = \frac{Profit_k - Profit_{k-1}}{1000 * \text{Metric Ton}}$$

- We simulate each quota change 40 times and use the convolution method to generate 1,600 simulated outcomes
- Construct 95% confidence intervals
- Profits are based on the catch of all species

Commercial Marginal Values for Preferred Model (Model 3)



Details for all 3 Models

Commercial Model Caveats

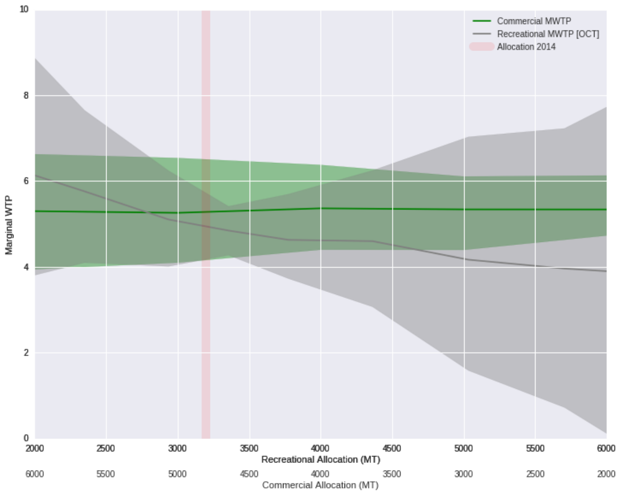
- Data relies on observer data so it is not a complete data set of all activity
- Short run analysis - prices are not endogeneous, exit/entry
- Model does not account for localized depletion of the resource
- Relies on historical data to characterize current conditions in fishery
- Focus on at-sea commercial behavior and ignores any changes in consumer and produce surplus in the commerical sector *solely due to quota changes* such as boating and dock services, and losses in consumer surplus for consumers of summer flounder.

Allocation Analysis

Equimarginal Principle

If the value of the last pound of fish allocated to the commercial sector is equal to the value of the last pound allocated to the recreational sector, we have maximized benefits to the nation from the fishery.

Marginal Analysis for the Preferred Models

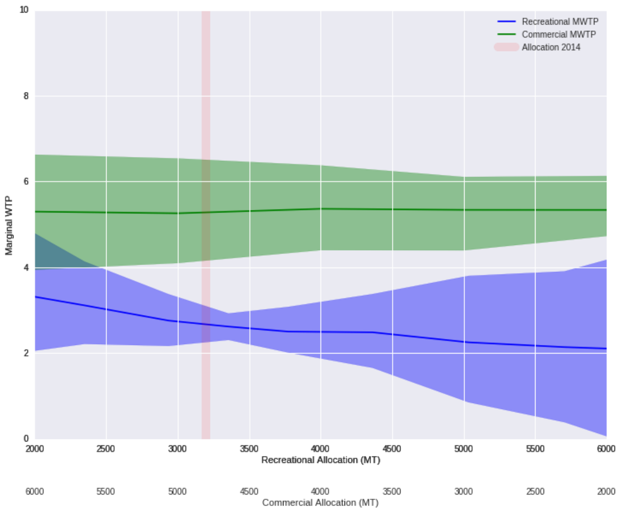


Recommendations

- Current allocations are close to, if not, optimal with respect to efficiency.
- Modest changes to quota allocations *in either direction*, would most likely not decrease national benefits flowing from the fishery.

Appendix

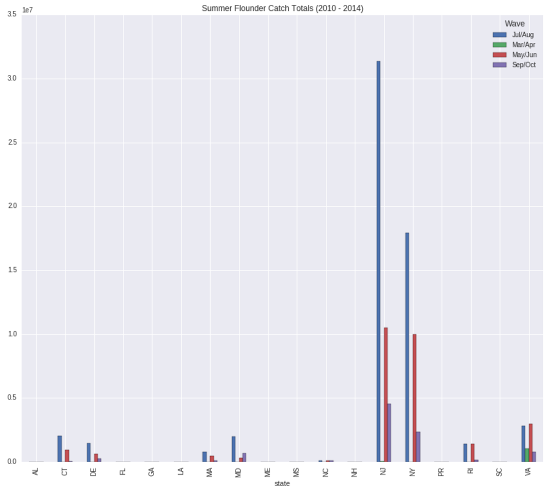
Marginal Benefits by Sector



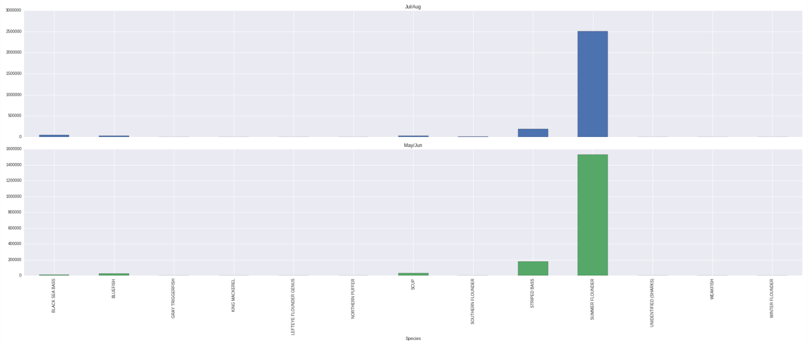
IT Infrastructure

	Recreational			Commercial		
	MySQL	Python	R	MySQL	Python	Matlab
Data Acquisition						
Clean Raw Data for DB storage		x		x	x	x
Store in Database	x	x		x	x	
Data Assembly						
Retrieve from DB	x	x		x	x	
Reshape for Econometric Model		x			x	x
Merge and combine		x				x
Survey adjusted Means and Totals		x	x	N/A	N/A	N/A
Store analysis data in DB	x	x				x
Econometric Model						
Retrieve from DB	x	x				x
Final Assembly		x				x
Model Estimation		x				x
Store parameters in DB	x	x				x
Policy Analysis						
Retrieve data and parameters from DB	x	x				x
Simulate Behavior		x				x
Calculate Policy Means and Totals		x	x			x

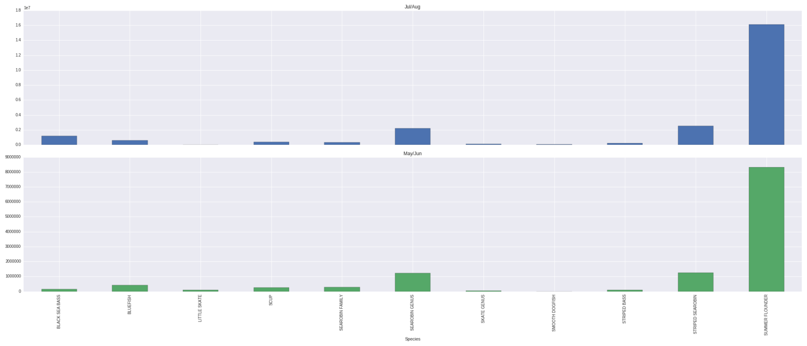
Summer Flounder Recreational Total Catch by State



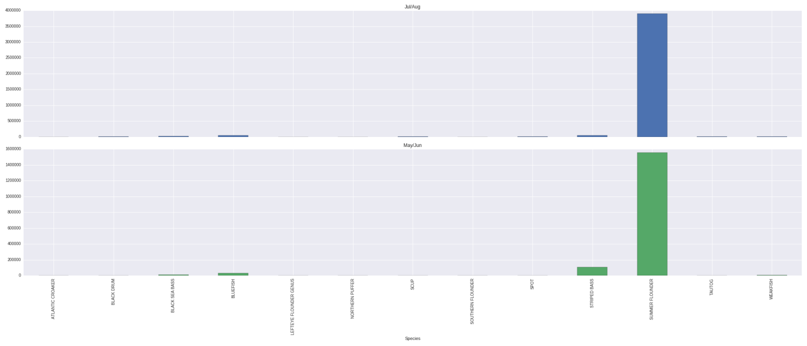
Summer Flounder in Context: Species Caught in NY



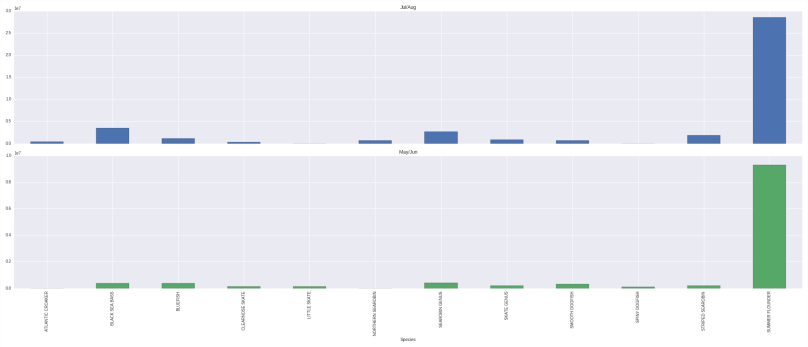
Summer Flounder in Context: Species Targeted in NY



Summer Flounder in Context: Species Caught in NJ

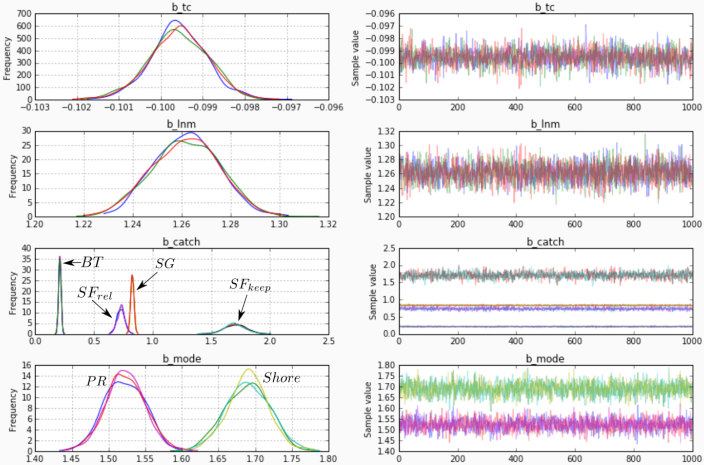


Summer Flounder in Context: Species Targeted in NJ



Back to Back to Presentation

Results: RUM Model



Results: RUM Model, cont.

	b_lnm	b_tc	b_bt	b_sg	b_sf_land	b_sf_rel	dum_pr	dum_sh
count	3000.000000	3000.000000	3000.000000	3000.000000	3000.000000	3000.000000	3000.000000	3000.000000
mean	1.261703	-0.099572	0.210776	0.828308	1.704043	0.730967	1.522743	1.690098
std	0.013695	0.000687	0.010831	0.014509	0.087752	0.032410	0.027029	0.029306
min	1.216995	-0.102108	0.169941	0.777885	1.384343	0.628437	1.433269	1.584659
25%	1.252193	-0.100009	0.203579	0.818566	1.644907	0.709574	1.504740	1.670539
50%	1.261834	-0.099575	0.210678	0.828181	1.702743	0.731825	1.522283	1.690711
75%	1.271136	-0.099108	0.217989	0.838124	1.763330	0.751281	1.541012	1.709710
max	1.315996	-0.096878	0.250116	0.877409	2.004679	0.841560	1.621508	1.788339

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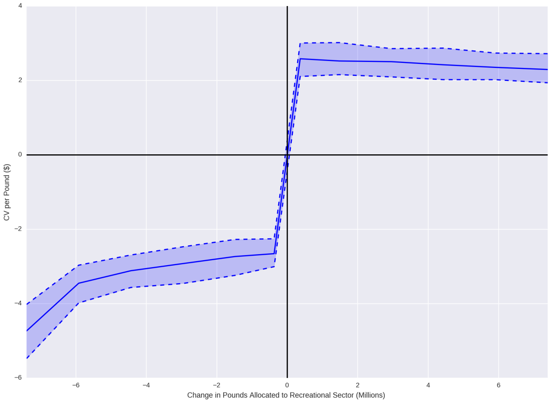
Table 3: Marginal Willingness to Pay by Quota Allocation

Quota (Pounds)	Quota (Metric Tons)	Lower 95% CI	Mean CV	Upper 95% CI
739,856	336	6.02	9.86	14.02
2,219,567	1,007	2.03	4.46	6.93
3,699,279	1,678	1.91	3.50	5.40
5,178,991	2,349	2.22	3.11	4.13
6,473,738	2,936	2.17	2.76	3.37
7,398,558	3,356	2.31	2.62	2.92
8,323,378	3,775	2.01	2.50	3.08
9,618,125	4,363	1.66	2.49	3.38
11,097,837	5,034	0.86	2.25	3.80
12,577,549	5,705	0.39	2.14	3.91
14,057,260	6,376	-0.35	2.07	4.52

Back to marginal value plot

Policy Simulations: CV per Pound



Back to Total CV

The Econometric Model: Expected Catch, Release, and Keep, cont.

In this study we need to analyze allocation policy which will alter landings (keep) of SF. So we calculate mean landings and release rates (numbers of fish) for each mode and site for summer flounder.

Choice Probability

Following normal conventions on assumptions about site, mode, and species specific errors (ϵ), we can model the probability that an individual chooses g (species), n (mode), and s (site) as

$$P(g, n, s) = \frac{e^{U(g,n,s)}}{\sum_{i \in G} \sum_{j \in M} \sum_{k \in S} e^{U(i,j,k)}}$$

Using likelihood contributions like this for each individual, we define the log-likelihood function.

Formal Recreational Choice Model

We assume an individual will choose species group g, mode n, and site s by comparing the alternative specific utilities if it is the best one:

$$U(g, n, s) + \epsilon_{g,n,s} > U(i, j, k) + \epsilon_{i,j,k} \forall i \in G, j \in M, k \in S$$

where all species groups are denoted by G, all modes M, and all sites S.

The Econometric Model: Site-Specific Utility Specification

Ignoring subscripts indexing individuals, we have for summer flounder the utility at each site k and mode j:

$$\begin{aligned} U(SF, j, k) = & \beta_{tc} TC_k + \beta_{lnm} log(M_k) \\ & + \beta_{SH}(mode_j == SHORE) \\ & + \beta_{PR}(mode_j == PRIVATE/RENTAL) \\ & + \beta_{SF,K} Keep_{SF,j,k} + \beta_{SF,R} Release_{SF,j,k} \end{aligned} \tag{2}$$

The Econometric Model: Site-Specific Utility Specification,cont.

For the other two species, we have similar specifications. For example, for bottom fish the utility at each site k and mode j:

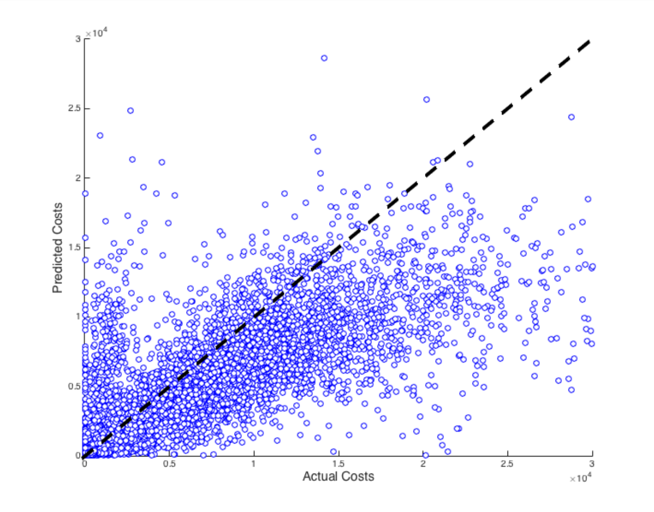
$$\begin{aligned} U(BT, j, k) =& \beta_{tc} TC_k + \beta_{lnm} log(M_k) \\ & + \beta_{SH}(mode_j == SHORE) \\ & + \beta_{PR}(mode_j == PRIVATE/RENTAL) \\ & + \beta_{BT} Catch_{BT,j,k} \end{aligned} \tag{3}$$

Back to Recreational Choice Model

Step 1: Estimating Trip Level Costs - Estimates

Parameter	Estimate	Parameter	Estimate	Parmeter	Estimate
Constant	-0.0457	February	-0.0858	New York	-0.4056***
	(0.7732)		(0.0916)		(0.1472)
Year 2000	-0.6720***	March	0.0151	North Carolina	0.0253
	(0.1996)		(0.0918)		(0.1783)
Year 2001	-0.7971***	April	0.0024	Rhode Island	-0.3363***
	(0.1894)		(0.1000)		(0.1343)
Year 2002	-0.3774**	May	-0.0509	ln(length)	0.8328***
	(0.1798)		(0.0927)		(0.2516)
Year 2003	-0.2969*	June	-0.0830	ln(gtons)	0.2952***
	(0.1703)		(0.0894)		(0.0897)
Year 2004	-0.4045**	July	-0.1384	ln(hp)	0.0197
	(0.1596)		(0.0854)		(0.0724)
Year 2005	0.0972	August	-0.2273***	ln(hold)	0.0076
	(0.1541)		(0.0876)		(0.0244)
Year 2006	0.2378	September	-0.1249	ln(crew)	0.2631**
	(0.1610)		(0.0903)		(0.1268)
Year 2007	0.1946	October	-0.1713*	ln(crew)*ln(crew)	-0.0659***
	(0.1597)		(0.0893)		(0.0704)
Year 2008	0.3645**	November	-0.0655	ln(steam)	0.3362***
	(0.1598)		(0.0882)		(0.0673)
Year 2009	-0.2033	Connecticut	-1.7158***	ln(steam)*ln(steam)	-0.0746***
	(0.1553)		(0.1972)		(0.0212)
Year 2010	0.1628	Maine	0.2317	ln(days)	0.7823***
	(0.1583)		(0.1620)		(0.1060)
Year 2011	0.3049*	Maryland	-1.0701***	ln(days)*ln(days)	0.1319***
	(0.1582)		(0.1826)		(0.0524)
Year 2012	0.1211	Massachusetts	0.0894	ln(hauls)	0.7095***
	(0.1598)		(0.1299)		(0.0707)
Year 2013	0.1334	New Hampshire	-0.1484	ln(hauls)*ln(hauls)	-0.1407***
	(0.1593)		(0.1724)		(0.0224)
January	-0.1165	New Jersey	-0.0608		
	(0.0888)		(0.1365)		
	Number of Obs.		13,667		
	Adjust. R^2		0.4064		

Step 1: Predictive Accuracy



Back to Commercial Trip Cost Model Summary

Choice Model Details

Individual i will choose site j if it is the best site:

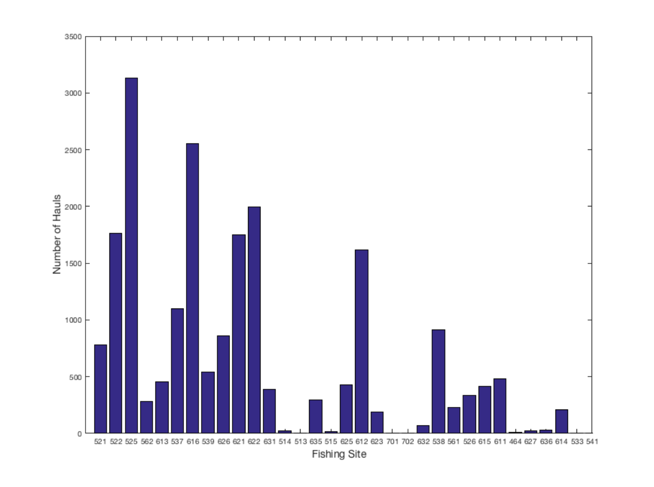
$$U_{ijt} + \epsilon_{ijt} > U_{ikt} + \epsilon_{ikt} \forall k \in S$$

For our application (subscripts for individual, site, and time dropped):

$$\begin{aligned} U = &\gamma_i + \beta_1 * Distance_{ijt} + \beta_2 * SF_{Revenues} + \beta_3 * BSB_{Revenues} + \\ &\beta_4 * SCUP_{Revenues} + \beta_5 * Other_{Revenues} + \beta + 6 * No_{Choice} \end{aligned} \tag{4}$$

Back to Commercial Choice Model Summary

Step 2: Histogram of Site Choices

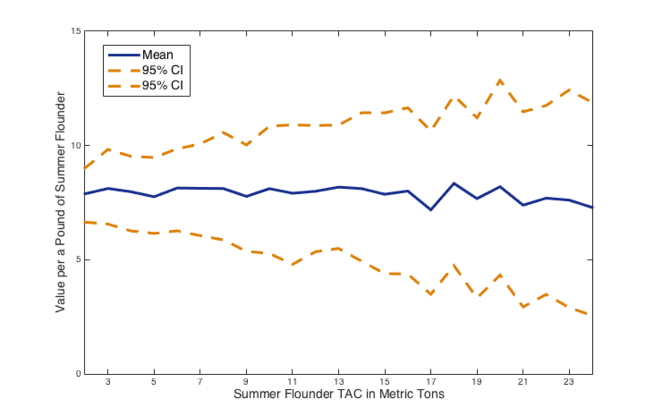


Step 2: RUM - Estimates

Parameter	Estimate	Parameter	Estimate	Parmeter	Estimate
Site 521	4.4020***	Site 635	-0.4230	Site 464	1.8833***
	(0.3006)		(0.3371)		(0.3911)
Site 522	5.3505***	Site 515	2.4091***	Site 627	-0.5034
	(0.3031)		(0.4037)		(0.3667)
Site 525	5.800***	Site 625	1.2879***	Site 636	-2.2462***
	(0.3037)		(0.3135)		(0.3974)
Site 562	3.7990***	Site 612	2.7808***	Site 614	1.9025***
	(0.3094)		(0.3025)		(0.3084)
Site 613	2.8342***	Site 623	0.8327***	Distance	-0.0348***
	(0.2994)		(0.3085)		(0.0003)
Site 537	4.0702***	Site 701	-3.6686***	SF Revenues	3.2105***
	(0.2962)		(0.7723)		(0.2709)
Site 616	3.9001***	Site 702	-3.6686***	BSB Revenues	1.0919**
	(0.2975)		(0.5113)		(0.5360)
Site 539	2.3813***	Site 632	-0.5209	SCUP Revenues	0.0218
	(0.2999)		(0.3440)		(0.4275)
Site 626	2.1421***	Site 538	3.3288***	Other Revenues	-0.3236***
	(0.3095)		(0.2978)		(0.0871)
Site 621	2.5530***	Site 561	3.4560***	No Choice	-1.7184***
	(0.3071)		(0.3122)		(0.0857)
Site 622	3.2530***	Site 526	2.9459***		
	(0.3027)		(0.3032)		
Site 631	0.2867	Site 615	2.2182***		
	(0.3248)		(0.3028)		
Site 514	1.2294***	Site 611	2.4216***		
	(0.3077)		(0.3004)		
Number of Obs.			20,900		
Log Likelihood (parameters=0)			-73,077		
Log Likelihood (estimates)			-17,219		

Back to Commercial Choice Model Summary

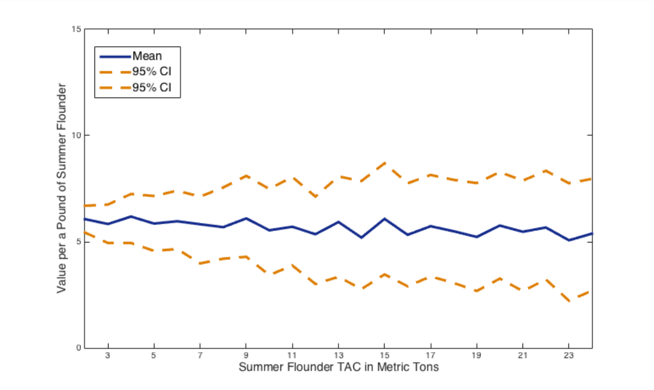
Marginal Values for Model 1



Marginal Value Model 1 - Results

Allocation (MT)	Mean	Lower 95% CI	Upper 95% CI
2,000	7.8851	6.6453	9.0162
3,000	8.1204	6.5616	9.8310
4,000	7.9752	6.2604	9.5245
5,000	7.7581	6.1539	9.4760
6,000	8.1402	6.2661	9.8561
7,000	8.1273	6.0551	10.0714
8,000	8.1179	5.8691	10.5694
9,000	7.7738	5.3696	10.0241
10,000	8.1125	5.2754	10.8474
11,000	7.9104	4.7984	10.9040
12,000	7.9971	5.3515	10.8735
13,000	8.1800	5.4952	10.8989
14,000	8.1137	4.9322	11.4363
15,000	7.8664	4.3919	11.4297
16,000	8.0085	4.3781	11.6515
17,000	7.1833	3.4895	10.6389
18,000	8.3415	4.7475	12.1810
19,000	7.6772	3.3215	11.2153
20,000	8.1974	4.3329	12.8512
21,000	7.3900	2.9345	11.4773
22,000	7.6961	3.4828	11.7511
23,000	7.6107	2.9050	12..4311
24,000	7.2882	2.5568	11.8850

Marginal Values for Model 2



Marginal Value Model 2 - Results

Allocation (MT)	Mean	Lower 95% CI	Upper 95% CI
2,000	6.0685	5.4347	6.6957
3,000	5.8368	4.9449	6.7553
4,000	6.1873	4.9453	7.2509
5,000	5.8575	4.5707	7.1560
6,000	5.9674	4.6613	7.4056
7,000	5.8262	3.9824	7.1283
8,000	5.6894	4.2051	7.5583
9,000	6.1013	4.2939	8.1041
10,000	5.5413	3.4329	7.4886
11,000	5.7093	3.8840	8.0508
12,000	5.3566	3.0163	7.1295
13,000	5.9295	3.3511	8.0747
14,000	5.1982	2.7767	7.8634
15,000	6.0796	3.4642	8.6992
16,000	5.3292	2.9072	7.7538
17,000	5.7339	3.3682	8.1471
18,000	5.4954	3.0646	7.9163
19,000	5.2289	2.6862	7.7639
20,000	5.7643	3.2661	8.2814
21,000	5.4730	2.6802	7.8814
22,000	5.6740	3.2282	8.3438
23,000	5.0712	2.2265	7.7550
24,000	5.3849	2.6989	7.9653

Marginal Value Model 3 - Results

Allocation (MT)	Mean	Lower 95% CI	Upper 95% CI
2,000	5.4827	4.7681	6.0625
3,000	5.3583	4.5628	6.2845
4,000	5.3298	4.2755	6.4238
5,000	5.3301	4.1458	6.5119
6,000	5.1533	3.8970	6.3929
7,000	5.3293	3.8611	6.7917
8,000	4.9791	3.5380	6.4686
9,000	5.4968	4.0064	6.7719
10,000	5.0561	3.5626	6.6672
11,000	5.0145	3.3164	6.7422
12,000	4.9652	3.1843	6.8668
13,000	5.0733	2.7426	7.5328
14,000	4.8105	2.4053	7.0192
15,000	4.7111	2.7840	6.5570
16,000	5.0148	2.7127	7.1172
17,000	4.9404	2.4938	7.3306
18,000	4.5149	2.3536	6.8245
19,000	5.3843	3.2686	7.7050
20,000	4.5178	2.9612	7.3274
21,000	5.1218	2.9612	7.3247
22,000	4.4040	1.6833	6.7396
23,000	5.0532	2.4101	7.8775
24,000	4.8707	2.1647	7.9001

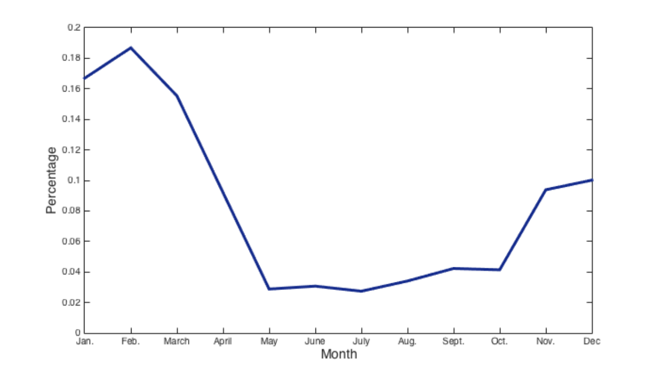
Back to marginal value plot

State Allocations

Table 4: State Allocations for Summer Flounder, Black Sea Bass and Scup

State	Percentage SF	Percentage BSB	Percentage SCUP
ME	0.0476%	0.1210%	0.5000%
NH	0.0005%	0.0000%	0.5000%
MA	6.8205%	21.5853%	13.0000%
RI	15.6830%	56.1894%	11.0000%
CT	2.2571%	3.1537%	1.0000%
NY	7.6470%	15.8232%	7.0000%
NJ	16.7250%	2.9164%	20.0000%
DE	0.0178%	0.0000%	5.0000%
MD	2.0391%	0.0119%	11.0000%
VA	21.3168%	0.1650%	20.0000%
NC	27.4458%	0.0249%	11.0000%

Seasonal Fishing Patterns



Policy Simulation Summary

Policy Analysis: CV for Keep versus Release of SF,cont.

Pre-policy Keep and Release rates at site k, mode j is $Keep^0_{SF,j,k}$ and $Release^0_{SF,j,k}$.

Following the policy change (for example giving more Keep to recreational anglers) Keep and Release change to

$$Keep^1_{SF,j,k} = Keep^0_{SF,j,k} \times (1 + \Delta) \tag{5}$$

$$Release^1_{SF,j,k} = Release^0_{SF,j,k} - \Delta \times Keep^0_{SF,j,k} \tag{6}$$

Note that: $Keep^1_{SF,j,k} + Release^1_{SF,j,k} = Keep^0_{SF,j,k} + Release^0_{SF,j,k}$

Policy Analysis: Quota Changes and Site Attributes

For a ΔQ pound change in the recreational quota from 2014 levels (Q_{2014}), we map quota changes to site specific catch changes by constructing Δ:

$$\Delta = \frac{\Delta Q}{Q_{2014}}$$

and apply the summer flounder catch rate formulas from the previous slide. Back to Policy Change Summary