Introduction to Stated Preference Choice Experiments and Their Use at NOAA Fisheries

Brad Gentner
Economist
Office of Science & Technology
Division of Economics and Social Analysis
NOAA Fisheries

Marine Recreational Fisheries Statistical Survey (MRFSS).

- Designed to estimate catch, effort and participation using a creel survey and an RDD survey.
- Economic data periodically collected using add-on surveys
  - Expenditure/impact
  - Revealed preference valuation
  - Stated preference valuation
    - Conjoint
    - Contingent valuation
    - Contingent behavior
  - Participation/demographic
  - For hire cost earnings

Revealed Preference vs. Stated Preference Techniques

- RP Uses
  - Damage assessment
  - Effects of closures
  - Large regional or national total value estimates
- Limitations
  - Little spatial/temporal variation in important policy variables
  - Cannot predict effort changes
  - Cannot predict substitution

What Is an SPCE?

- Current incarnation from marketing literature
- Decomposes a good into some or all of its attributes
- Asks respondents to choose or rank 2 or more goods with differing attributes
- Allows examination of changes in angler welfare based on changes in the attributes.
- Estimates changes in effort based on angler behavior – a key for assessing the economic impacts of policies.

Angler Utility

- **Angler utility**

$$U_j\left(X_j,\varepsilon_j\right)=V_j\left(X_j\right)+\varepsilon$$

- **An angler will choose trip j if;**

$$V_j\left(X_j\right)+\varepsilon_j \geq V_k\left(X_j\right)+\varepsilon_k, j\in S, \forall k\in S$$

- **Generalize to include sub-sets of the global choice set S;**

$$V_j\left(X_j\right)+\varepsilon_j \geq V_k\left(X_k\right)+\varepsilon_k, j\in S, \forall k\in S_i, S_i\subset S$$

Potential Attributes

- Cost
  - Travel or trip cost for recreational surveys
  - Program or policy cost for non-use values
- Brand – species target in our recreational example
- States of nature attributes
  - Air and water quality
  - Catch and keep rates, etc.
- Policy attributes
  - Implicitly assumes two effects in utility – policy effect and outcome effect
  - Some controversy here

Steps to Develop an SPCE

- Define Attributes
  - Qualitative research driven
  - Policy driven
  - Theory driven
- Develop experimental design
- Test qualitatively and quantitatively
- Iterate

Experimental Design

- Seven, 3-level attributes across a paired choice experiment yields a full factorial with 85 million possible combinations.
- All 2^{nd} order and higher effects can be estimated if a fractional factorial is balanced and orthogonal
- Balance and orthogonality difficult to achieve.

Model Estimation

- Same exact modeling technique as revealed preference models – Random Utility Model
- Angler's discrete choice is examined with a conditional logit model
- Welfare calculations and effort changes predicted with parameterized model
- Technical details available from me or any one of the references at the end of this presentation

2000 Mail Add-On Survey

Even if you don't fish for summer flounder, your answers to these questions will help us understand what is important to anglers when choosing saltwater trips.

11. Suppose **last August** that you could have chosen ***only*** from the recreational opportunities described below. Please review the trip descriptions and answer the two questions at the bottom of the table.

	Trip A	Trip B	Trip C
Cost of traveling to the site	$ 40	$ 40	
Likely total catch of summer flounder	8 fish	11 fish	
Minimum size limit for summer flounder	14 inches	15 inches	Do something else, but not take a saltwater fishing trip.
Bag limit for summer flounder	12 fish	6 fish	
Likely number of summer flounder of legal size	3 fish	3 fish	
Likely fishing success for all other species	Average	Above Average	
11a) Which trip do you MOST prefer? (Please check ***only one*** box.)	☐	☐	☐
11b) Which trips would you SERIOUSLY consider taking? (Please check ***all*** that apply.)	☐	☐	☐

2000 Attribute Levels

Attribute	Definition	Ranges
Cost of traveling to a site	Includes gas, wear and tear on your vehicle and other expenses you might have from traveling to and from a fishing access site (such as tolls, ferry fees, and parking fees).	{$5, $20, $30, $40, $55}
Bag limit for summer flounder	The most summer flounder an angler can legally keep per day of fishing.	{1, 4, 6, 8, 12} (fish)
Minimum size limit for summer flounder	Summer flounder smaller than a minimumsize limit must be released.	{12, 14, 15, 16, 18} (inches)
Likely catch of summer flounder	Anglers never know exactly how many summer flounder they will catch when they take a trip. However, they often have an	{2, 5, 8, 11, 14} (fish)
Likely fishing success for all other species	When taking a trip, anglers might also be interested in catching species besides summer flounder. Fishing success refers to the expected number of fish caught for all other species that you might encounter for	{Below Average, Average, Above Average}
Likely Number of summer flounder of legal size	Anglers also are never sure of the size of summer flounder they will catch.	{0, 1, 3, 6, 10} (fish)

- N = 8279 choices across 2154 individuals (avg. 3.84 choices per individual out of a possible 4)

2001 Summer Flounder Regulations

State	Minimum Size Limit	Possession Limit	Open Season
Massachusetts	15.5"	8	May 10 - Oct. 2
Rhode Island	15.5"	8	May 10 - Oct. 2
Connecticut	15.5"	8	May 10 - Oct. 2
New York	15.5"	8	May 10 - Oct. 2
New Jersey	15.5"	8	May 6 - Oct. 20
Delaware	15.5"	8	May 10 - Oct. 2
Maryland Bays	15.0"	8	May 15 - Dec. 31
Maryland	15.5"	8	April 15 - Dec. 11
Potomac River	15.5"	8	May 15 - Dec. 31
Virginia	15.5"	8	March 29 - July 23 Aug. 2 - Dec. 31
North Carolina	15.5"	8	Jan. 1 - Dec. 31

Source: Atlantic States Marine Fisheries Commission, personal correspondence, May 14, 2001.

Policy Simulations

Bag Limit	Size Limit	Season Length	Value Change (per trip average)	Effort Change	Expenditure Change
1	0	0	$4.61	22,725	$1,284,417
0	-1	0	$3.30	15,464	$874,025
0	0	-1	-$5.58	-50,776	-$2,869,860
-1	0	-1	-$9.55	-72,591	-$4,102,843
-1	1	-1	-$11.43	-83,189	-$4,701,842

Bag Limit	Size Limit	Season Length	Sales Impact	Income Impact	Employment Impact
1	0	0	$2,880,945	$977,135	33
0	-1	0	$1,960,437	$664,924	23
0	0	-1	-$6,437,089	-$2,183,278	-74
-1	0	-1	-$9,202,669	-$3,121,284	-106
-1	1	-1	-$10,546,223	-$3,576,979	-122

2004 Mail Add-On Survey

B3 **Please look at the table, compare all the features of each fishing trip, and then answer the question below.**

Definitions

- **Target species:** The species of fish you expect to catch on the trip.
- **Total number of fish caught per trip:** Your expected total catch of the target species. Your total may be restricted by the bag limit and/or the minimum size limit.
- **Bag limit:** The number of the target species that you are legally allowed to keep per fishing trip.
- **Minimum size limit:** The minimum length of the target species that you may keep. You are not legally allowed to keep fish that measure less than this length.
- **Catch at or above minimum size:** Your expected catch of the target species that are equal to or longer than the minimum size limit.
- **Trip cost:** Includes your personal share of the costs associated with gas, wear and tear on your vehicle, tolls, ferries, parking, access fees, food, ice, bait, and fishing equipment used on this trip.
- **Other fish:** Any fish you might expect to catch on a fishing trip for the target species (not including the target species).

Features	Trip A	Trip B	No Trip
Target species	Grouper	King Mackerel	Do something else, but not take a saltwater fishing trip.
Total number caught per trip	6 Grouper	1 King Mackerel	
Bag limit	3 Grouper	5 King Mackerel	
Minimum size limit	20 inches	28 inches	
Catch at or above the minimum size	6 Grouper	1 King Mackerel	
Trip cost	$140	$140	
Catch of target species you are legally allowed to keep	3 Grouper	1 King Mackerel	
Catch of other fish you are legally allowed to keep	3 fish	6 fish	

Which trip would you choose? Please select only one.

- ○ **Trip A**
- ○ **Trip B**
- ○ **No Trip**

2004 Regulations for Base Case

	Current Bag Limit	Current Size Limit
GROUPER	5	24"
RED SNAPPER	4	16"
DOLPHIN	10	20"*
KING MACKEREL	2	24"

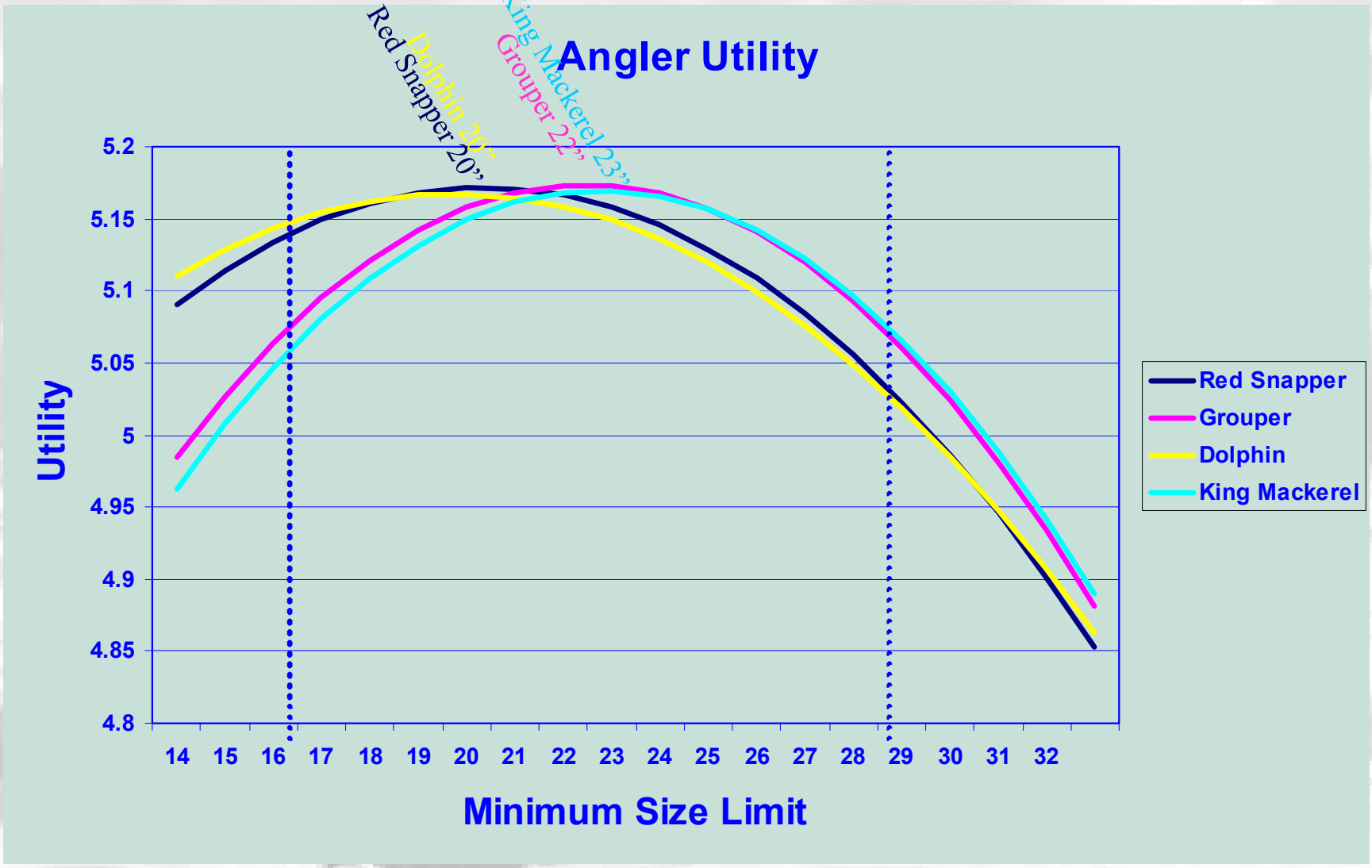
*only in force in Georgia's state waters (< 3 miles), but proposed for Federal waters

2004 Descriptive Statistics

Variable	Levels Used in Experimental Design	Mean	Standard Error
K_BAG	1, 2, 3, 5	2.70	0.0227
D_BAG	6, 10, 15, 20	12.98	0.0857
G_BAG	1, 2, 3, 6	3.00	0.0295
R_BAG	1, 2, 3, 5	2.86	0.0238
TC	$45, $70, $105, $140	59.92	0.3324
OTHER	1, 3, 6	2.22	0.0148
K_SIZE	20", 24", 28"	24.00	0.0504
D_SIZE	18", 20", 24"	20.69	0.0403
G_SIZE	18", 20", 24"	20.71	0.0395
R_SIZE	16", 18", 22"	18.65	0.0400
K_LEGAL	1, 2, 3, 5	2.42	0.0217
G_LEGAL	1, 2, 3, 6	3.12	0.0319
D_LEGAL	1, 3, 6, 10	4.37	0.0522
R_LEGAL	1, 2, 3, 5	2.55	0.0235

- N = 8010 choices across 1436 individuals (avg. 5.6 choices per individual out of a possible 8)
- Brands almost equally represented: 26% King Mackerel, 25% Grouper, 24% Dolphin, and 25% Red Snapper

Minimum Size Limit Attribute



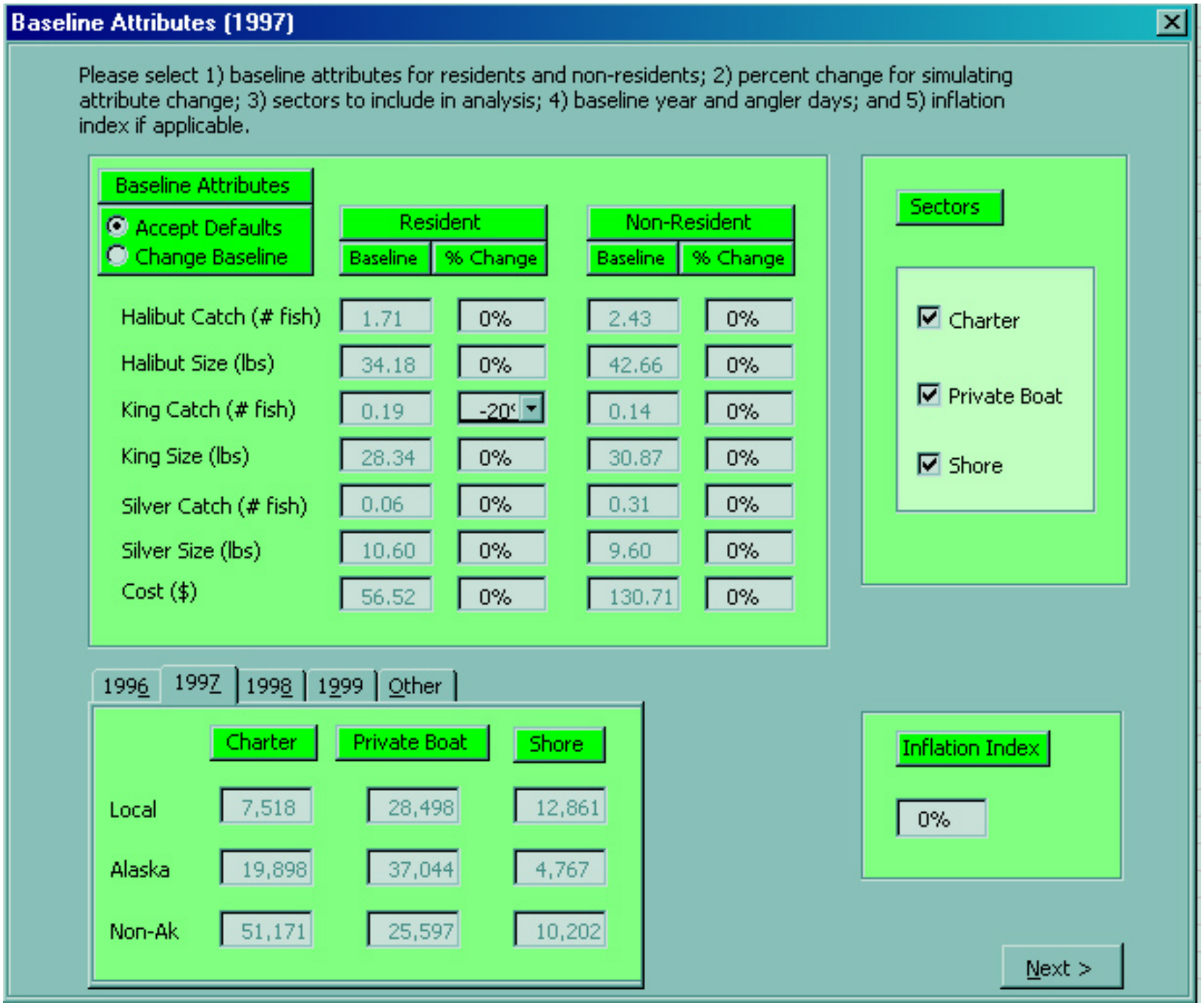
Regulations: Red Snapper = 16”, Dolphin 20”, Grouper and King Mackerel = 24”

Policy Simulation: Two Fish Decrease (50% Reduction) in Red Snapper Bag Limit

Brand	Base		Scenario		Net Change	
	%Share	Number	%Share	Number	% Change	Trip Change
GROUPER	28.32	2269	27.268	2184	-1.05%	-85
RED SNAPPER	23.084	1849	17.904	1434	-5.18%	-415
DOLPHIN	12.898	1033	15.404	1234	2.51%	201
KING MACKEREL	26.356	2111	28.184	2258	1.83%	147
NO TRIP	9.343	748	11.239	900	1.90%	152
Total	100	8010	100	8010	0.00%	0

Welfare Loss and Economic Impacts

		1: Reduction in Keep from 4 to 2 Fish		Changes in Expenditures	
Target Species	2003 Effort	Share Change	Effort Change	Average Trip Cost	Total Expenditure Change
Grouper	32,418	-1.05%	-340	$67.20	-$22,874
Red Snapper	18,891	-5.18%	-979	$89.01	-$87,101
King Mackerel	35,851	1.83%	656	$69.09	$45,328
Dolphin	17,556	2.51%	441	$50.60	$22,297
No Trip		1.90%	-359	$68.98	-$24,757
Net Loss			-581		-$67,107
Welfare Effects					
CV per Trip			$132.28		
Welfare Loss			$2,498,901		
Expenditures and					
Sales Impacts			-$150,521.01		
Income Impacts			-$51,052.45		
Job Losses			-1.74		


Baseline Attributes (1997)
Please select 1) baseline attributes for residents and non-residents; 2) percent change for simulating attribute change; 3) sectors to include in analysis; 4) baseline year and angler days; and 5) inflation index if applicable.
Baseline Attributes
Accept Defaults
Change Baseline
Resident
Baseline
% Change
Non-Resident
Baseline
% Change
Halibut Catch (# fish) 1.71 0% 2.43 0%
Halibut Size (lbs) 34.18 0% 42.66 0%
King Catch (# fish) 0.19 -20% 0.14 0%
King Size (lbs) 28.34 0% 30.87 0%
Silver Catch (# fish) 0.06 0% 0.31 0%
Silver Size (lbs) 10.60 0% 9.60 0%
Cost ($) 56.52 0% 130.71 0%
Sectors
Charter
Private Boat
Shore
1996
1997
1998
1999
Other
Charter
Private Boat
Shore
Local 7,518 28,498 12,861
Alaska 19,898 37,044 4,767
Non-Ak 51,171 25,597 10,202
Inflation Index
0%
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Baseline Data

	Baseline Attributes		% Change Applied to		Varied Attributes		Sectors Included for Analysis:
	Resident Means	Non-Resident Means	Resident Means	Non-Resident Means	Resident Means	Non-Resident Means	Charter Private Boat Shore
Halibut Catch	1.71	2.43	0%	0%	1.71	2.43	
Halibut Size	34.18	42.66	0%	0%	34.18	42.66	
King Catch	0.19	0.14	-20%	0%	0.15	0.17	
King Size	28.34	30.87	0%	0%	28.34	30.87	**Inflation Factor:**
Silver Catch	0.06	0.31	0%	0%	0.06	0.31	0%
Silver Size	10.60	9.60	0%	0%	10.60	9.60	
Cost	56.52	130.71	0%	0%	$56.52	$130.71	

Change in resident effort: -2.46%
Change in non-resident effort: 0.00%

Overall change in effort: -1.54%

Change Data

Estimated Angler Days				
	Charter	Private	Shore	Total
Local	7,518	28,498	12,861	48,877
Alaska	19,898	37,044	4,767	61,709
Non-AK	51,171	25,597	10,202	86,970
Total	78,587	91,139	27,830	197,556

Simulated Change In Angler Days				
	Charter	Private	Shore	Total
Local	-185	-702	-317	-1,204
Alaska	-490	-913	-117	-1,521
Non-AK	0	0	0	0
Total	-676	-1,615	-434	-2,725

Simulated Angler Days				
	Charter	Private	Shore	Total
Local	7,333	27,796	12,544	47,673
Alaska	19,408	36,131	4,650	60,188
Non-AK	51,171	25,597	10,202	86,970
Total	77,911	89,524	27,396	194,831

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Economic Impacts

Response Coefficient Type: Output

Sectors Included for Analysis: Charter, Private Boat, Shore	Baseline Angler Expenditures ($)	Direct Output ($)	Indirect Output ($)	Induced Output ($)	Total Output ($)
Transportation, Food & Lodging					
Auto or Truck Fuel	2,619,715	(28,888)	(6,911)	(6,996)	(42,712)
Groceries	2,864,102	(28,818)	(3,705)	(7,845)	(40,287)
Lodging	3,226,870	(21,907)	(4,919)	(4,191)	(29,233)
Restaurant & Bar	2,561,923	(22,312)	(4,477)	(4,203)	(30,991)
Fishing Expenditures					
Boat Fuel, Lubricants & Repairs	1,732,240	(21,534)	(4,614)	(4,965)	(31,060)
Charter & Guide Fees	10,366,927	(57,077)	(18,027)	(12,850)	(87,953)
Fish Processing or Packaging	2,307,448	(5,628)	(723)	(1,002)	(7,353)
Fishing Derby Entry Fees	269,302	(1,209)	(299)	(229)	(1,737)
Fishing Gear	1,904,030	(5,483)	(815)	(1,212)	(7,494)
Haul Out & Moorage Fees	671,617	(5,001)	(1,436)	(743)	(7,178)
Totals	**$28,524,174**	**(197,858)**	**(45,925)**	**(44,235)**	**(285,999)**

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Compensating Variations

Baseline Average Compensating Variation			
Residency	Estimated Days Fished	Daily CV ($)	Total CV ($)
Local Alaska Residents	48,877	80.33	3,926,510
Non Local Alaska Residents	61,709	80.33	4,957,363
Non Residents	86,970	118.88	10,338,807
Total			$ 19,222,680

Simulated Change in Average Compensating Variation			
Residency	Estimated Days Fished	Daily CV ($)	Total CV ($)
Local Alaska Residents	(1,204)	(4.59)	(315,696)
Non Local Alaska Residents	(1,521)	(4.59)	(398,578)
Non Residents	-	-	-
Total			$ (714,274)

Simulated Average Compensating Variation			
Residency	Estimated Days Fished	Daily CV ($)	Total CV ($)
Local Alaska Residents	47,673	75.74	3,610,814.20
Non Local Alaska Residents	60,188	75.74	4,558,784.98
Non Residents	86,970	118.88	10,338,806.56
Total			$ 18,508,406

Print Return

Discussion

- Success!!
- Currently expensive and slow
- Could easily include more substitute species
- Estimates sensitive to experience with brands
- Estimates very robust with regards to sample size
- Optimum administration – do it interactively?

References and Upcoming SPCE's

Summer flounder 2000

Massey, Matt, Steve Newbold, and Brad Gentner. (forthcoming).Valuing water quality changes using a bioeconomic model of a coastal recreational fishery. Journal of Environmental Economics and Managment.

Alaska salmon and halibut anglers in 2002 and upcoming in 2005

Criddle, K. R., Herrmann, M., Lee, T. S., and Hamel, C. (2003). Participation Decisions, Angler Welfare, and the Regional Economic Impact of Sportfishing. *Marine Resource Economics.* 18(4), pp. 291-312.

Texas Red Drum anglers in 2002

Oh, Chi-Ok, Robert Ditton, Brad Gentner, and Robin Reichers. (2005). A Stated Preference Choice Approach to Understanding Angler Preferences for Management Options. Human Dimensions of Wildlife. Volume 10 Number 3. pp173-186.

Oregon and Washington salmon, halibut, and rockfish anglers – forthcoming

California salmon, halibut, rockfish, and coastal pelagics in 2006

Marine Protected Areas - 2005

Eco-labeling - 2005