A Recreation Demand Model for South Atlantic Marine Recreational Private and For-Hire Boat Fishing with an Application to Snapper Grouper Management

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Abstract: The South Atlantic Fishery Management Council is pursuing a “visioning” process for the snapper grouper fishery. Science is one of strategic goals with emphasis on quality data and economic impacts of management. In this context, we present a recreation demand model specifically designed for the South Atlantic region which is an improvement over existing models that support management decisions. The values that result can be applied to the quotas and site closures. For example, an estimate of the value of the reduced catch of red grouper from 2008 to 2012 is $1.1 million in 2012. An estimate of the value of avoiding a closure of the snapper grouper fishery in Florida is $1.57 million. Similar regional and species-specific models should routinely be estimated and employed by regional fishery councils as determined by management needs.

Key words: Fisheries management, recreation demand, snapper grouper

JEL Codes: Q22, Q26, Q51

Introduction

The South Atlantic snapper grouper complex, which includes sixty species managed by the South Atlantic Fisheries Management Council (SAFMC), is an important commercial and recreational fishery with many stocks that suffer from overfishing. Since December 2012 the SAFMC has pursued a “visioning” process for this fishery involving development of goals, objectives and strategies related to the draft vision statement: “The snapper grouper fishery is a healthy, sustainable fishery that balances and optimizes benefits for all citizens.” During its September 2013 meeting, the SAFMC decided upon “science” as one of its four strategic goals. The first objective of the science goal is to “obtain quality data to monitor and assess biological, economic, and social impacts of management.”

While sound science in support of economic optimization is a goal of fisheries management, current efforts use outdated economic information about the recreational fishery. The South Atlantic Snapper Grouper Fishery Management Plan (FMP[2]) uses recreational value estimates from a 2001 National Marine Fisheries Service study (Haab, Whitehead and McConnell 2001). Snapper grouper FMPs beginning in 2004 with Amendment 12 which “set regulatory limits for red porgy” and as recently as 2012 with Amendment 24 which “proposed measures to end overfishing and establish a rebuilding plan for red grouper” have included the following text intended to establish baseline recreational values and provide evidence of economic importance:

[2] The FMP can be found at http://safmc.net/resource-library/snapper-grouper.

Estimates of the economic value of a day of saltwater recreational fishing in the South Atlantic indicate that the mean value of access per marine recreational fishing trip is $109.31 for the South Atlantic (Haab et al. 2001). While this estimate is not specific to snapper grouper fishing trips, it may shed light on the magnitude of an angler's willingness to pay for this type of recreational experience.

Willingness to pay for an incremental increase in catch and keep rates per trip was also estimated to be $3.01 for bottom fish species by Haab et al. (2001). … Finally, Haab et al. (2001) provided a compensating variation (the amount of money a person would have to receive to be no worse off after a reduction of the bag limit) estimate of $2.49 per fish when calculated across all private boat anglers that targeted snapper grouper species in the South Atlantic.

These values are dated. Haab, Whitehead and McConnell (2001) estimate a two-step nested logit model of the South Atlantic and Gulf of Mexico recreational fishery using data from the 1997 add-on to the Marine Recreational Fishery Statistics Survey (MRFSS) (Hicks et al. 1999). In a two-step, sequential nested random utility model, conditional logit site selection models are first estimated then mode-target conditional logit models are estimated with the resulting inclusive values. The sequential model is less efficient and can result in downward biased second stage standard errors. In addition, target species groups are big game, small game, bottom fish (including snapper grouper and other species) and flat fish. These groupings were developed by McConnell and Strand

(1994) almost twenty years ago and are not conducive for current fisheries management support in the South Atlantic.

In this paper we present an existing, but previously unpublished, recreation demand model of the South Atlantic private and for-hire boat fishery with snapper-grouper as a target species using the 2000 MRFSS with economic add on data. The model was developed specifically for the South Atlantic region in terms of target species and is estimated as one-step full-information maximum likelihood nested random utility model. While this model does not use the most recent data (i.e., Marine Recreational Information Program, MRIP, data), it is an improvement over Haab, Whitehead and McConnell (2001) and illustrates an approach that fishery management councils should consider. Given today's econometric software and computational power, marine recreational fishing demand models should be designed specifically for regional fishery management councils and the species and species groups that they manage. These region- and species-specific models could then be employed in FMPs as needed. In the rest of this paper we present the South Atlantic model, data and results with an application to the snapper grouper fishery.

Model

Consider an angler who chooses from a set of recreation sites. The individual utility from the trip is decreasing in trip cost and increasing in trip quality, $u_i = v_i(y - c_i, q_i) + \varepsilon_i$, where u is the individual indirect utility function, v is the nonstochastic portion of utility, y is the per-trip recreation budget, c is the trip cost, q is a vector of site qualities, ε is the error term, and i is one of s recreation sites, s = 1, … , i ,

… J. The choice amongst fishing alternatives involves M groups of species-mode nests, $m = 1, \dots, M$. Within each nest is a set of J_m sites, $j = 1, \dots, J_m$. When the nest chosen, n, is an element in M, the site choice, i, is an element in J_n and the error term is distributed as generalized extreme value the choice probability in a two-level nested logit model is

$$\pi_{ni} = \frac{e^{v_{ni}/\theta}\left[\sum_{j=1}^{J_n} e^{v_{nj}/\theta}\right]^{\theta-1}}{\sum_{m=1}^{M}\left[\sum_{j=1}^{J_m} e^{v_{mj}/\theta}\right]^{\theta}}$$

, where the numerator is the product of the utility resulting from the choice of nest n and site i and the summation of the utilities over sites within the chosen nest n. The denominator of the probability is the product of the summation over the utilities of all sites within each nest summed over all nests. The dissimilarity parameter, $0 \leq \theta \leq 1$, measures the degree of similarity of the sites within the nest. As the dissimilarity parameter approaches zero the alternatives within each nest become less similar to each other when compared to sites in other nests. If the dissimilarity parameter is equal to one, the nested logit model collapses to the conditional logit model where $M \times J_m = J$. The random utility model assumes that the individual chooses the alternative that gives the highest utility, $\pi_{ni} = \Pr(v_{ni} + \varepsilon_{ni} > v_{ns} + \varepsilon_{ns} \ \ \forall\, ns \neq ni)$.

Welfare analysis is conducted by specifying a linear functional form for the site utilities, $v_{ni}(y - c_{ni}, q_{ni}) = \alpha y - \alpha c_{ni} + \beta' q_{ni}$, where α is the marginal utility of income. Since αy is a constant it will not affect the probabilities of site choice and can be dropped from the utility function. Haab and McConnell (2003) show that the willingness-to-pay for a quality change (e.g., changes in catch rates) can be measured as

$$WTP(\Delta q \mid ni) = \frac{\beta_q \Delta q}{\alpha}$$

. The willingness-to-pay to avoid the loss of an alternative (e.g., site closure) is $WTP(j,) = \frac{\ln[((1-\Pr(j \mid m))^{\theta}\Pr(m) + (1-\Pr(m)]}{\alpha}$. The welfare measures apply for each choice occasion (i.e., trips taken by the individuals in the sample).

Data

The 2000 MRFSS South Atlantic intercept data is combined with the economic add-on to characterize anglers and their fishing choices. Measures of fishing quality for individual species and aggregate species groups are calculated using the MRFSS creel data (Hicks et al. 1999). We focus on private/rental and for-hire (party/charter) boat hook-and-line day trip anglers interviewed from North Carolina to Florida. We exclude anglers with missing data on their primary target species, those that self-reported a multiple day trip and that live greater than 200 miles from the nearest site. Estimation with overnight trips tends to produce upwardly biased estimates of consumer surplus (McConnell and Strand, 1999).

Travel costs are measured as the product of round trip travel distance and an estimate of the cost per mile. In addition, a measure of lost income is included for anglers who lost wages during the trip. Travel distance is calculated with the software program PCMiler. For anglers who indicate they lost income by taking the trip, travel costs are defined as the sum of the explicit travel cost (i.e., round trip distance valued at $0.30 per mile) and the travel time valued at the wage rate. Travel time is calculated by dividing the travel distance by an assumed 40 miles per hour for travel. For anglers that do not forego wages to take a trip, travel cost is simply defined as the explicit travel cost. All for-hire boat anglers are assigned the average charter boat fee for the east coast of Florida ($107) obtained from Gentner, Price and Steinbeck (2001).

There are 31 county level fishing sites in the model. Each of these counties is comprised of a varying number of MRFSS intercept sites. We include the log of the number of MRFSS intercept sites in each county to control for site aggregation bias (Parsons and Needleman 1993). The average number of MRFSS intercept sites in each county is 19.

We focus our model on recreational species with management interest in the South Atlantic. We consider three species aggregates: big game, small game and snapper-grouper. In the big game aggregate most of the anglers target dolphin while others target atlantic tarpon, billfish family, blackfin tuna, cobia, little tunny, sailfish, swordfish, tuna genus, wahoo, and yellowfin tuna. In the small game species aggregate most of the anglers target king mackerel, red drum, spotted seatrout and Spanish mackerel. In the snapper-grouper species aggregate, anglers target sheepshead, red snapper and other species. We measure catch rate with the historic targeted harvest (hereafter, catch is synonymous with harvest). Five year (1995-1999) targeted historic catch rates per day are calculated using MRFSS data in each county of intercept to measure site quality.

Anglers choose among two fishing modes and three target species aggregates. There are six mode/species alternatives in the model. In the for-hire mode: (1) four percent (n = 130) of all anglers target big game and choose among 12 county fishing sites, (2) three percent (n = 101) target small game and choose among 14 sites and (3) two percent (n = 59) target snapper-grouper and choose among 7 sites. In the private/rental boat mode: (4) twenty-two percent (n = 754) of all anglers target big game and choose among 17 fishing sites, (5) sixty-one percent (n = 2066) target small game and choose among 27 sites and (6) eight percent (n = 271) target snapper-grouper and choose among 22 sites.

Over all 3381 trips and 100 alternatives the average travel cost for boat trips is $250. Average big game catch is 0.09 per day trip (including zeros for nontargeted trips). Small game targeted catch per day is 0.25 fish. Snapper-grouper targeted catch per day is 0.28 fish per day trip. The average of the log of the number of interview sites in each county is 2.94.

Results

We regress the mode/species/site selection decision on trip cost, catch rates, the log of interview sites and alternative specific dummy variables for the private boat mode interacted with target species (Table 1). The results indicate that the models are adequate depictions of marine recreational fishing behavior. The model likelihood ratio statistics indicate that all parameters are jointly significantly different from zero.

The likelihood that an angler would choose a fishing site is negatively related to the travel cost and positively related to the catch rates. The coefficients on the alternative specific constants are each negative indicating that there are net costs associated with private boat trips relative to for-hire trips (e.g., fuel costs). The estimate of the dissimilarity parameter is statistically different from zero and one which indicates that the nesting structure is appropriate.

The willingness-to-pay values for catch of one additional fish per trip are presented in Table 2. The willingness-to-pay values for big game, small game and snapper-grouper are $52, $6 and $14. Ninety-five percent confidence intervals indicate that each of these values is significantly different from zero. These values can be applied to the catch of each species of fish. For example, according to the NMFS[3], 90,329 red grouper were harvested in the South Atlantic in 2008. Harvest fell to 11,798 in 2012. Our estimate of the value of the reduced harvest from 2008 to 2012 is $1.1 million in 2012.

In Table 3 we present the willingness-to-pay per trip to avoid site-mode closure in the snapper-grouper fishery. The largest value is $1.62 to avoid closure of the private/rental boat snapper grouper fishery in Florida. According to the NMFS[3], 967 thousand private/rental boat fishing trips were taken in the EEZ of the South Atlantic coast of Florida in 2012. Our estimate of the willingness-to-pay to avoid the loss of the site-mode alternative is $1.57 million.

Conclusions

In this paper we present results from a South Atlantic private and for-hire boating recreational demand model with a focus on the snapper grouper fishery. The paucity of up-to-date recreation demand models to support fisheries management decisions belies their ease of estimation and the availability of data. This paper illustrates the potential use of a basic model for management decisions. These models should be estimated annually

[3] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division December 10, 2013.

using MRIP data and results such as these should be considered in the SAFMC snapper grouper visioning process and fishery management plans.

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Table 1.Nested Logit Recreation Demand Regression Results

	Coefficient	t-statistic
Travel cost	-0.033	-52.18
Big game catch	1.71	9.51
Small game catch	0.18	2.02
Snapper-grouper catch	0.46	4.83
Log(# sites)	1.03	25.34
Private Boat mode x target big game	-1.46	-6.59
Private Boat mode x target small game	-0.031	-0.09
Private Boat mode x target snapper grouper	-2.78	-15.68
θ	0.84	10.28
Angler trips	3381	
Alternatives	100	

Table 2. Willingness-to-pay for one fish per trip (harvest)

Species	WTP	95% Confidence Interval	
Big game	51.88	40.67	63.16
Small game	5.56	0.30	10.84
Snapper-grouper	14.07	8.38	20.27

Table 3. Willingness-to-pay to avoid snapper-grouper closure per trip

Location - mode	WTP	95% Confidence Interval	
North Carolina – for-hire	0.41	0.39	0.42
South Carolina – for-hire	0.05	0.05	0.05
Georgia – for-hire	0.00	0.00	0.00
Florida – for-hire	0.09	0.09	0.09
North Carolina - private/rental	0.33	0.32	0.35
South Carolina - private/rental	0.14	0.14	0.15
Georgia - private/rental	0.12	0.12	0.13
Florida - private/rental	1.62	1.56	1.68