CONJOINT ANALYSIS OF THE MID-ATLANTIC FOOD-FISH MARKET FOR FARM-RAISED HYBRID STRIPED BASS

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Abstract

Conjoint analysis was used to examine buyer preferences toward farm-raised hybrid striped bass at the wholesale, retail, and restaurant levels. Low price and round form were found to be important attributes in the product preference rating for the wholesale and retail markets. The filleted form contributed the most to restaurants' preference rating. Following these, larger fish size was preferred by all markets.

Key words: conjoint analysis, hybrid striped bass, market preference, aquaculture.

INTRODUCTION

There has been significant interest in developing an aquaculture industry in the mid-Atlantic region as an alternative to traditional grain crop and livestock enterprises. Hybrid striped bass, developed by crossing the striped bass (*Morone saxatilis*) and white bass (*Morone chrysops*), has been identified as one of the best potential species for aquaculture development in the mid-Atlantic region (Strand and Lipton). The striped bass is one of the most important recreational and commercial species on the U.S. Atlantic Coast. There was an 88 percent decline in total landings of striped bass from 1973 to 1983. The declines in wild striped bass populations and the closure of many commercial fisheries have greatly decreased the supply of striped bass in established East Coast seafood markets. The demand for striped bass appears sufficient to sustain a strong mid-Atlantic aquaculture industry well into the future (Carlberg and Van Olst; Helfrich et al.). Private and government marketing experts estimate a beginning market of 52 million pounds of hybrid striped bass product. According to the USDA, at that production level, producers' gross income would be about $182 million. Studies by Liao and Smith in 1987 and by Lipton and Swartz in 1988 showed that hybrid striped bass are highly acceptable to consumers, wholesalers, and retailers and appear to be an excellent market substitute for wild striped bass.

The success of aquaculture ventures depends largely on the marketability of the product. The largest market for farm-raised fish is the traditional food-fish market consisting of seafood wholesalers, retailers, and restaurants. The aquaculturist may distribute fish products directly to retailers and restaurants or by the conventional, established network of fish brokers and wholesalers (Helfrich et al.). These market levels (wholesale, retail, restaurant) differ in their requirements, with the differences related to fish attributes. To achieve market penetration, a supplier has to know which product attributes influence buyer purchasing decisions and how the buyer evaluates products based on the attributes (Lipton and Swartz).

Previous marketing studies on buyer preferences toward farm-raised hybrid striped bass products all involved market surveys in which respondents were asked to rank each product's attributes. One major problem with ranking of preferences of product attributes comes from the nature of the decision-making process. In all cases, the characteristics of products that a buyer must choose from have more than one dimension, i.e., they are multiattribute. The buyer must make an overall judgment about the relative value of those characteristics or attributes (Green and Wind).

The objective of this study is to analyze the purchase preference of mid-Atlantic seafood buyers when purchasing farm-raised hybrid striped bass. Specifically, the study will determine utility values for different levels of four hybrid striped bass product attributes for various market levels (wholesale, retail, restaurant). The relative importance of various hybrid striped bass product attributes will be calculated from the estimated attribute utility values. The utility values will also be employed within a simulation framework to demonstrate how buyer preferences for different farm-raised hybrid striped bass

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product configurations can be calculated so that producers can design products that match the preference of particular market levels.

METHODOLOGY

Conjoint measurement is a multivariate market research technique which can aid in sorting out the relative importance of a product's multidimensional attributes (Green and Wind). Conjoint measurement refers to any decompositional method that estimates the structure of buyers' preferences given the buyers' overall evaluations of a set of alternative products that are prespecified in terms of levels of different attributes (Green and Srinivasan). Using conjoint measurement, a researcher can make inferences about buyer attitudes and preferences toward specific components. The specific steps in a conjoint measurement experiment include conjoint design and administration.

Conjoint Design

The conjoint design includes two basic steps. First, the attributes and attribute levels which together make up the design specifications must be carefully chosen. These attributes reflect key product characteristics or dimensions which buyers can use to assess the product. The attributes should include those most relevant to potential buyers (Cattin and Wittink). Attribute levels correspond to points along these dimensions and should cover the entire range of representative levels.

The selection of farm-raised hybrid striped bass attributes and attribute levels was based upon *a priori* knowledge of seafood marketing, a review of past fish marketing studies, and discussions with several large-volume fish buyers in the mid-Atlantic region. The selected attributes are size, form, seasonal availability, and purchase price. Their respective attribute levels are: 1.0, 2.0, and 3.0 lbs. in the round for size; round, gutted, and filleted for form; April to October only and year-round for seasonal availability, and $2.00, $4.00 and $6.00 per pound for price.

Once the attributes and attribute levels have been selected, they must be combined into hypothetical farm-raised hybrid striped bass products and preference ratings must be assigned to the products. This study's conjoint experiment uses a full-profile approach, in which respondents rate a set of "total" hypothetical products. In this approach, product profiles are constructed by selecting one level from each attribute. However, this can generate large numbers of product profiles if full factorial designs are used. In this study, there are four attributes which include three attributes with three levels each and one attribute with two levels, such that there are 3 x 3 x 2 x 3, or 54 possible product profiles. To cope with the large numbers of product profiles, researchers often use fractional factorial designs to reduce the number. A fractional factorial design is a sample of attribute levels selected from a full factorial design without losing information to effectively test the effects of the attributes on buyer's preferences.

The most commonly used method of constructing fractional factorial design in conjoint measurement is the orthogonal array. Orthogonal arrays build on the Graeco-Latin squares by developing highly fractionated designs in which the product profiles are selected so that the independent contributions of all main effects are balanced, assuming negligible interactions (Green and Wind). Orthogonal array designs are used because they have many desirable properties. First, they allow one to gather data on a large number of product profiles using a relatively small number of product profiles. Second, from a statistical perspective, orthogonal designs are most efficient. This study used Bretton-Clark's Conjoint Analyzer software to construct the nine product profiles used in the survey. The conjoint design generated consists of nine hypothetical fresh farm-raised hybrid striped bass product profiles as is shown in Table 1.

Table 1. Hypothetical Farm-Raised Hybrid Striped Bass Product Profiles

Product Profile	Fish Size	Product Form	Seasonal Availability	Purchase Price
1	3.0 lb	Round	Year-Round	$6.00/lb
2	2.0 lb	Gutted	Apr. - Oct.	$6.00/lb
3	3.0 lb	Gutted	Year-Round	$4.00/lb
4	1.0 lb	Gutted	Year-Round	$2.00/lb
5	1.0 lb	Filleted	Year-Round	$6.00/lb
6	3.0 lb	Filleted	Apr. - Oct.	$2.00/lb
7	2.0 lb	Round	Year-Round	$2.00/lb
8	2.0 lb	Filleted	Year-Round	$4.00/lb
9	1.0 lb	Round	Apr. - Oct.	$4.00/lb

Conjoint Administration

A survey was constructed to elicit preference ratings for each of the nine product profiles shown in Table 1. A cover letter explained the need for information on fish buyers' preferences for the attributes that fish farmers (but not traditional suppliers) have control over such as size, time of harvest, and form.

Respondents were asked to rate each profile on a scale from 0 (least preferred) to 10 (most preferred). To aid respondents in this task, the instructions indicated that a rating of 10 could correspond to a "3.0 lb., filleted, year-round, $2.00/lb." product profile, while a rating of 0 could correspond to a "1.0 lb., round, April to October only, $6.00/lb." product profile. In addition, the following information was provided on the amount of dressed fillet that can be obtained from various sizes of hybrid striped bass in the round: a single 10-ounce portion fillet can be obtained from a 1.5 lb. hybrid striped bass fish, and two 8-ounce fillets can be obtained from a 2.5 lb. fish. The purpose of this information was to provide respondents with standardized measures in case they attempted to consider how they could take a product profile of a certain form and size and convert it into a different profile of another form and size. Thus it was possible for a respondent with the appropriate facilities to consider Profile 1 in Table 1 (3.0 lb. round) as convertible to about 1.2 lbs. of fillets.

The survey was conducted from July to September 1989. A list of 2,485 seafood wholesalers, retailers, and restaurants from the mid-Atlantic region (New York Metro, New Jersey, Philadelphia Metro, Maryland, Delaware, Washington, D.C., Virginia, and North Carolina) was obtained from Dun's Marketing and a questionnaire was sent to each firm on the list. Responses were received from 296 of those firms (91 wholesalers, 84 retailers, and 121 restaurants), for a response rate of 12 percent. It is possible that the response rate could actually have been closer to 24 percent of the intended population of "fish-buying firms" since it was subsequently determined that about half of the firms on the original list sold only shellfish. In addition to the low overall response rate not all of the returned surveys were complete. Thus there were only 1,790 usable observations (preference ratings) out of a possible 2,664.

MODEL SPECIFICATION

Conjoint preference models, once specified, can be used to estimate parameters of various attributes with the preferences indicated by the respondents. The specification of the conjoint preference model involves two steps. First, the functional form for each attribute must be specified. Next, the functional forms for each attribute are combined into a conjoint preference model for estimation.

Attribute Functional Forms

According to traditional marketing studies, qualitative attributes use the 'part-worth' or dummy variable specification. However, there are two possible functional forms for quantitative attributes with two to three attribute levels: the 'vector' or linear specification, and the 'ideal-point' or quadratic specification. Many marketing researchers normally use *a priori* notions to determine the shape of an attribute's functional form. To verify our hypothesized notions of the type of functional forms, scatter plots of buyer's utility ratings with the various levels of the quantitative attributes and the significance levels of the estimated coefficient when subjected either to linear or quadratic forms were examined to determine the final functional form. For this study, fish size is modelled using the quadratic functional form, and purchase price uses the linear functional form. Product form and seasonal availability variables utilize the 'part-worth' or dummy variable specification.

Conjoint Preference Model Development

In the econometric specification of buyer preference, the attributes are combined to formulate a conjoint preference model. The model for this study can be expressed as follows

(1) Rating = f(Size, Form, Season, Price)

where:

Rating = preference rating given hypothetical hybrid striped bass products by survey respondent
Size = fish size in the round (1.0 lb, 2.0 lb or 3.0 lb)
Form = fish product form (round, gutted, or filleted)
Season = fish seasonal availability (Year–round or April–October only)
Price = fish purchase price ($2.00/lb, $4.00/lb or $6.00/lb).

This study employs "mean deviation coding," for the dummy variable specification. This dummy variable coding technique is equivalent to traditional dummy variable coding from a mathematical point of view. Using mean deviation coding, the coefficient for the base level is easily calculated as the negative sum of the (k-1) level coefficients. The intercept becomes the mean preference rating, and dummy variable coefficients measure deviation from the mean rating.

Market-Level Variables.

Since most aquacultural marketing studies report results separately for different market levels (wholesale, retail, restaurant), it is important to determine whether there are preference differences among them (Rogness and Lin; Lipton and Swartz; and Liao and Smith). Traditional conjoint studies accomplish this by disaggregating the respondent preference ratings data and analyzing the data separately by each market level. However, disaggregated results do not provide information on the statistical significance of inter-market levels differences. In this study, dummy variables for each market level were incorporated in the conjoint preference model. These variables reveal how the base preference level (represented by the intercept term) varies between market levels. Attribute-market interaction dummy variables were also incorporated in the model. These 'slope-dummies' indicate how slopes change between market levels for the different attribute variables.

The conjoint preference model incorporating both attribute and market level variables, specified with the chosen functional forms, can then be expressed as in equation (2):

$$\begin{aligned}(2)\ \text{Rating} = {} & \beta_0 + \beta_1\,\text{Sz} + \beta_2\,\text{SzSq} + \beta_3\,\text{FmG} \\ & + \beta_4\,\text{FmF} + \beta_5\,\text{SnY} + \beta_6\,\text{Pr} + \beta_7\,\text{IndRE} \\ & + \beta_8\,\text{IndRS} + \beta_9\text{Sz\_IndRE} \\ & + \beta_{10}\text{Sz\_IndRS} + \beta_{11}\text{SzSq\_IndRE} \\ & + \beta_{12}\,\text{SzSq\_IndRS} + \beta_{13}\text{FmG\_IndRE} \\ & + \beta_{14}\text{FmG\_IndRS} + \beta_{15}\text{FmF\_IndRE} \\ & + \beta_{16}\text{FmF\_IndRS} + \beta_{17}\text{SnY\_IndRE} \\ & + \beta_{18}\text{SnY\_IndRS} + \beta_{19}\text{Pr\_IndRE} \\ & + \beta_{20}\text{Pr\_IndRS}\end{aligned}$$

where:

Sz = fish size (1.0 lb, 2.0 lb or 3.0 lb)
SzSq = size × size
FmG = dummy variable for Gutted product form
FmF = dummy variable for Filleted product form
SnY = dummy variable for Year-Round availability
Pr = fish purchase price ($2.00/lb, $4.00/lb, or $6.00/lb)
IndRE = dummy variable for Retail industry
IndRS = dummy variable for Restaurant industry
_ = interaction between market and attribute levels.

THE ESTIMATED CONJOINT PREFERENCE MODEL

Table 2 shows the mean preference ratings for the nine survey products along with their standard errors and standard deviations. Depending on the markets, product profiles 6, 7, and 8 received the higher ratings while product profile 1 received the lowest rating as expected. The conjoint preference model was estimated using ordinary least squares (OLS). In general, the model performs very well. Over 52 percent of the t-values are significant at the 0.01 level, and 67 percent of the t-values are significant at the 0.10 level. The adjusted R-Square of 0.286 is somewhat low, due to the cross-sectional nature of the data. Table 3 lists the estimated model parameters. Table 4 lists the calculated parameters for the base level attribute and market level variables, as well as for the base level attribute-market interaction variables. The coefficient for the 'k'th base level of each dummy variable, is calculated as the negative sum of the (k-1) level coefficients. For example, using this formula, the calculated coefficient for FormR (round product form) is -0.7852 [-(FormG + FormF)]. The calculated coefficient for SeasonAO (seasonal availability of April-October only) is -0.2801, the negative of SeasonY (Year-Round).

Table 2. Mean Preference Ratings, Standard Error (SE) and Standard Deviation (SD) for the Hypothetical Farm-Raised Hybrid Striped Bass Product Profiles

Product Profile	Wholesale			Retail			Restaurant		
	mean	SE	SD	mean	SE	SD	mean	SE	SD
1	1.98	0.42	3.23	0.95	0.26	2.03	1.78	0.32	2.78
2	1.95	0.38	2.86	1.33	0.32	2.53	2.27	0.33	2.87
3	4.47	0.49	3.76	3.86	0.48	3.86	4.47	0.44	3.78
4	4.72	0.48	3.62	4.89	0.51	4.11	4.75	0.44	3.93
5	3.19	0.45	3.37	2.77	0.41	3.17	3.61	0.40	3.45
6	6.76	0.45	3.44	7.14	0.50	3.97	8.40	0.31	2.81
7	7.06	0.40	3.15	7.87	0.40	3.32	4.44	0.46	3.93
8	6.00	0.44	3.37	6.22	0.49	3.92	7.27	0.35	3.17
9	2.77	0.42	3.18	2.62	0.41	3.26	1.92	0.30	2.57

Table 3. Estimated Conjoint Model Parameters

Variable	Parameter Estimate	Standard Error	T Statistic[a]
Intercept	3.9243	0.6338	6.192 ***
Sz	4.4792	0.6823	6.565 ***
SzSq.	-1.0000	0.1686	-5.930 ***
FmG	-0.6415	0.1129	-5.681 ***
FmF	1.4267	0.1127	12.662 ***
SnY	0.2801	0.0847	3.305 ***
Pr	-1.0078	0.0488	-20.661 ***
IndRE	-0.3049	0.9025	-0.338
IndRS	0.4714	0.8627	0.546
Sz_IndRE	1.6052	0.9715	1.652 *
Sz_IndRS	-1.6532	0.9318	-1.774 *
SzSq_IndRE	-0.4497	0.2402	-1.872 *
SzSq_IndRS	0.4759	0.2304	2.066 **
FmG_IndRE	-0.1829	0.1607	-1.138
FmG_IndRS	0.1481	0.1540	0.961
FmF_IndRE	0.2407	0.1610	-1.495
FmF_IndRS	0.6785	0.1529	4.438***
SnY_IndRE	0.0848	0.1207	0.703
SnY_IndRS	-0.1782	0.1154	-1.544
Pr_IndRE	-0.2324	0.0695	-3.344 ***
Pr_IndRS	0.1802	0.0665	2.709 ***
F-Statistic	36.908		
R-Square	0.2943		
Adj. R-Square	0.2863		
Observations	1,790		

[a] T-statistics for mean deviation coded dummy variables indicate whether the variables are significantly different from the mean preference value.
*** Implies significance at the 0.01 level.
** Implies significance at the 0.05 level.
* Implies significance at the 0.10 level.

Fish Attribute Variables

All parameters for fish attribute variables without market level effects are significant at the 0.01 level. For fish size, a quantitative variable modelled with the ideal-point or quadratic functional form, both the linear component (Sz) and the curvilinear component (SzSq) were significant at the 0.01 level. The sign for Sz was positive, the sign for SzSq was negative, as expected, indicating that there is an ideal-point for fish size, and that fish size preference decreases as fish size changes from the ideal-point. Purchase price, the quantitative variable modelled with the vector or linear functional form, had a coefficient of -1.0078, showing that buyer utility decreases as price increases, as expected.

Table 4. Calculated Parameters for Base Level Dummy Variables and Attribute-Market Interactions Variables

Variable	Calculated Parameter	Standard Error	T Statistics[a]
FmR	- 0.7852	0.1128	- 6.962***
SnAO	- 0.2801	0.0847	- 3.305***
IndWH	- 0.1665	0.9222	- 0.181
Sz_IndWH	0.0480	1.0009	0.048
SzSq_IndWH	- 0.0262	0.2443	- 0.107
FmR_IndWH	0.4030	0.1635	2.465***
FmR_IndRE	0.4236	0.1604	2.642***
FmR_IndRS	- 0.8266	0.1545	- 5.350***
FmG_IndWH	0.0348	0.1642	0.212
FmF_IndWH	- 0.4378	0.1639	- 2.671***
SnY_IndWH	0.0934	0.1233	- 0.758
SnAO_IndWH	- 0.0934	0.1233	- 0.758
SnAO_IndRE	- 0.0848	0.1207	- 0.703
SnAO_IndRS	- 0.1782	0.1154	1.544*
Pr_IndWH	0.0522	0.0709	0.071

[a] T-statistics for effects-coded dummy variables indicate whether the variables are significantly different from the mean preference value.
*** Implies significance at the 0.01 level.
* Implies significance at the 0.10 level.

The relative effect of different levels of qualitative variables (product form and season) on the product preference rating can be determined by comparing the estimated and calculated dummy variable coefficients for each attribute. Of the three product forms, filleted product (FormF), with a coefficient of 1.4267 has the greatest effect on preference rating, with gutted (FormG) next at -0.6415, and round (FormR) at -0.7852 having the lowest effect on product preference rating. Year-round availability (SeasonY) at 0.2801 is preferred over availability from April-October only (SeasonAO) with a coefficient of -0.2801.

Market-Level Variables

The coefficients estimated for the market-level variables (IndRE and IndRS) tell how much the mean preference level (represented by the intercept term) differ from market to market. Comparing the three market-level variable coefficients shows that the restaurant market has the greatest effect on the intercept, indicating that the restaurant market segment mean preference level for farm-raised hybrid striped bass products is higher than the mean preference levels for either the wholesale or retail markets. The dummy variables for all the markets were not significant. This indicates that preference by the

wholesale, retail, and restaurant markets were not significantly different from the overall mean preference level.

Attribute-Market Interaction Variables

The attribute-market interaction parameters found in Tables 3 and 4 provide information about preference differences between market levels for the different attributes, allowing for market-level interpretation of buyer preferences. These 'slope-dummy' variables indicate the magnitude and direction of attribute variable slope changes for the different markets. The results show that slope changes for both the linear and curvilinear components of fish size were significantly different from mean levels for both the retail and restaurant. This suggests that there are market-level differences in fish size preference. The same appears true for the role of purchase price market-level interaction terms in determining preference. The price-market interaction terms for both the retail (Pr_IndRE) and restaurant (Pr_IndRS) markets differed significantly from the mean level.

The coefficients for the interaction between filleted product form and restaurants and wholesale were also significantly different from the mean preference level. The positive coefficient for restaurants suggests that the filleted product form is significantly more important to the seafood restaurants than for either wholesalers or retailers. This is in agreement with the study by Wirth where 69.4 percent of seafood restaurant buyers preferred filleted fish, compared to 27.5 percent for wholesalers and 29.8 percent for retailers.

RESULTS EVALUATION AND MARKET SIMULATION

One application of the estimated conjoint preference model is to utilize the estimated and calculated coefficients, which are in essence a measure of utility values of the attributes, to compute relative importance.

Attribute Utility Values

Since information on attribute utility values on a market-level basis is useful for the hybrid-striped bass industry, the conjoint model parameters are adjusted to provide this information. This is a two-step process. First, the intercept coefficient is added to each of the market-level coefficients to compute the separate market intercept parameters. For example, the intercept coefficient (3.924) is added to the -0.305 retail market coefficient (IndRE) which is equal to 3.619, to get the computed retail market intercept. Next, to compute the parameters for each attribute for the separate markets, the attribute coefficients were added to the different attribute market interaction coefficients to arrive at the attribute parameters for each of the attributes. For example, the estimated Sz coefficient of 4.479 was added to the Sz_IndRE coefficient of 1.605 to give a retail market Sz coefficient of 6.084. Table 5 lists the adjusted fish attribute parameters, by market. For quantitative variables such as price and size, the parameters are marginal utility values, while qualitative variables such as form and season availability can be interpreted as strictly utility values.

Calculation of Utility Values

The market-adjusted attribute parameters in Table 5 are used to compute attribute utility values, by market, for the different attribute levels. This information can then be used for calculating the total utility of realistic product profiles. Table 6 lists the computed utility values for the selected attribute levels.

The attribute utility values shown in Table 6 provide information on the highest-utility attribute levels for each market segment for the selected attribute levels. For wholesalers and retailers, highest utility for fish size occurs between 2.0 to 2.5 pound fish. For restaurants the highest fish size utility occurs between 2.5 and 3.0 pound fish. Of the three product forms, the filleted product form has the highest utility for all market levels. Wholesale and retail markets prefer round over gutted while the reverse is true for restaurants. This suggests that restaurants prefer a more processed product so as to reduce the time needed for preparation. Year-round availability also has higher buyer utility than April through October seasonal availability only. Buyer utility for purchase price decreases as purchase price increases, as expected. The highest purchase price utility occurred at $2.00 per pound, with retail markets having the lowest utility at all price levels among the mar-

Table 5. Fish Attribute Parameters by Market Adjusted by Attribute Market-Level Interactions

	Wholesale	Retail	Restaurant
Intercept	3.758	3.619	4.396
Size	4.527	6.084	2.826
SizeSq	-1.026	-1.450	-0.524
FormR	-0.382	-0.362	-1.612
FormG	-0.607	-0.824	-0.493
FormF	0.989	1.186	2.105
SeasonY	0.373	0.365	0.102
SeasonAO	-0.373	-0.365	-0.102
Price	-0.956	-1.240	-0.828

Table 6. Attribute Level Utility Values for Each Market[a]

	Wholesale	Retail	Restaurant
Base Level	3.758	3.619	4.396
Fish Size			
1.0 lb	3.501	4.634	2.302
1.5 lb	4.482	5.864	3.060
2.0 lb	4.950	6.368	3.556
2.5 lb	4.905	6.148	3.790
3.0 lb	4.347	5.202	3.762
Product Form			
Round	- 0.382	- 0.362	- 1.612
Gutted	- 0.067	- 0.824	- 0.493
Filleted	0.989	1.186	2.105
Seasonality			
Year-Round	0.373	0.365	0.102
Apr. - Oct.	- 0.373	- 0.365	- 0.102
Purchase Price			
$2.00/lb	- 1.912	- 2.480	- 1.656
2.50/lb	- 2.390	- 3.100	- 2.070
3.00/lb	- 2.868	- 3.720	- 2.484
3.50/lb	- 3.346	- 4.340	- 2.898
4.00/lb	- 3.824	- 4.960	- 3.312
4.50/lb	- 4.302	- 5.580	- 3.726
5.00/lb	- 4.780	- 6.200	- 4.140
5.50/lb	- 5.258	- 6.820	- 4.554
6.00/lb	- 5.736	- 7.440	- 4.968

[a] Utility values can be compared within a market level, but cannot be compared across markets because of shifts in base level values between markets.

kets suggesting relatively more importance placed on price compared to other markets.

Relative Importance of Attributes

A common way of summarizing conjoint results is to compute attribute importance weights within each market level (Cattin and Wittink). Since all utility function results are expressed in a common unit, utility ranges can be compared from attribute to attribute to calculate their relative importance in the preference rating (Green and Wind). The relative importance of attributes is calculated in the following manner: First, for each attribute, determine the highest and lowest utility values for the attribute. The difference between the highest and lowest utility values is the attribute utility range. Next, take the sum of the ranges over all attributes. The relative importance of an attribute (i) is defined as:

$$(3) \quad \text{relative importance(i)} = \frac{100 \times \text{range(i)}}{\Sigma \text{ ranges(i)}}.$$

Table 7 gives the calculated relative importance of each hybrid striped bass attribute, by market. The relative importance weights are expressed as percentages.

The most striking find from Table 7 is the similarity between the wholesale and retail markets. In both cases, the relative importance weights are almost identical. Purchase price was the most important attribute in the preference rating, contributing over 50 percent to the rating. Product form and fish size weights were similar for both markets, accounting for 18 to 21 percent of the preference ratings. The restaurants contrasted sharply with the wholesalers and retailers. Product form was the most important attribute for restaurants, accounting for 42.8 percent of the preference rating. Purchase price, at 38.1 percent, was close to product form in importance.

Market Simulations

The buyer utility for any feasible product is the sum of the utility value for the base market level plus the sum of the utility values for each selected product attribute.

$$(4) \quad \text{Utility} = \text{Base Level Utility} + \Sigma \text{ Attribute Level Utilities}$$

The attribute utility values in Table 6 can be incorporated in Equation 4 to compare the overall buyer utilities for different realistic hybrid striped bass products. Table 8 provides overall buyer utility values for the nine farm-raised hybrid striped bass products. These product configurations are developed based on current mid-Atlantic market conditions on sea trout which is a close substitute to hybrid striped bass (Wirth).

Examination of the buyer utility values for the different farm-raised hybrid striped bass product configurations illustrates the relative importance of purchase price and form for wholesalers and retailers

Table 7. Relative Importance of Attributes in Preference Rating for Each Market

Attribute	Wholesale	Retail	Restaurant
	percent		
Fish Size	19.028	18.380	16.795
Product Form	20.959	21.306	42.758
Seasonality	9.796	7.738	2.347
Purchase Price	50.217	52.576	38.100

Table 8. Fish Buyer Utilities for Alternative Farm-Raised Hybrid Striped Bass Products

Product Configuration				Utility Value		
Size	Form	Season	Price	Wholesale	Retail	Restaurant
1.0 lb	Round	Yr. Round	$3.00/lb	4.374	4.536	2.704
1.5 lb	Round	Yr. Round	$3.00/lb	5.363	5.766	3.462
2.5 lb	Round	Yr. Round	$3.00/lb	5.786	6.050	4.192
1.0 lb	Gutted	Yr. Round	$4.00/lb	3.679	2.834	2.995
1.5 lb	Gutted	Yr. Round	$4.00/lb	4.182	4.064	3.753
2.5 lb	Gutted	Yr. Round	$4.00/lb	4.605	4.348	4.483
1.0 lb	Filleted	Yr. Round	$5.50/lb	3.363	2.984	4.351
1.5 lb	Filleted	Yr. Round	$5.50/lb	4.344	4.214	5.109
2.5 lb	Filleted	Yr. Round	$5.50/lb	4.385	4.498	5.839

and of product form for restaurants. In the wholesale and retail markets, the utility for a 2.5 pound round fish at $3.00 per pound, available year round only, is higher than the utility for the 2.5 pound filleted fish, available year-round at $5.50 per pound, which is a realistic purchase price. In the restaurant market, filleted fish in most cases have higher buyer utilities than round and gutted fish. However, for any fish form, larger size is preferred. The 2.5 pound filleted fish, available year-round at $5.50 per pound, has higher utility than the 1.0 pound filleted fish, available year-round at $5.50 per pound. This suggests that restaurants prefer fillets coming from larger size fish. In summary, given various sizes, forms, and prices which reflect the processing cost, the wholesale and retail markets prefer round and larger size fish, and restaurants prefer filleted fish also coming from a larger fish.

SUMMARY AND CONCLUDING REMARKS

This study used conjoint analysis to provide market information on mid-Atlantic buyer preferences toward farm-raised hybrid striped bass. The result of the conjoint analysis showed that the most important attribute of the hybrid striped bass product, contributing over 50 percent to the preference ratings of wholesalers and retailers, was purchase price and form. On the other hand, product form was the most important attribute to restaurants, accounting for almost 42 percent of the restaurant preference rating (i.e., filleted fish was preferred over other forms). Season availability was not as important an attribute as expected, although year-round products were generally preferred. Market simulation on realistic product profiles showed that wholesalers and retailers prefer round in the larger size with purchase price representative of current processing costs, and restaurants prefer fillets coming from a larger fish. The simulation findings of realistic hybrid striped bass products, based on the current mid-Atlantic market conditions suggest that fish farmers with current technology may achieve greatest market acceptance and market penetration in the mid-Atlantic region by growing farm-raised hybrid striped bass between 2 to 3 pounds.

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