



USING NATIONAL RETAIL DATABASES TO DETERMINE MARKET TRENDS FOR SOUTHERN AQUACULTURE PRODUCTS

Reporting Period

June 1, 2009 – August 31, 2013

Funding Level	Year 1	\$123,930
	Year 2	\$124,462
	Year 3 (Supplement)	\$ 73,683
	Year 4 (Supplement)	\$ 76,322
	Total	\$398,397

Participants	Mississippi State University	Jimmy Avery (Project Leader)
	University of Arkansas at Pine Bluff	Madan M. Dey, Carole Engle
	Texas Tech University.....	Benaissa Chidmi
	Auburn University.....	Terry Hanson
	University of Florida	Sherry Larkin, Charles Adams

PROJECT OBJECTIVES

1. Compile historical data on retail price and sales volumes of major aquaculture species and competing products in key cities and regions in the United States.
 - a. Convene a project planning meeting.
 - b. Procure store-level scanner data for the most recent 5 years and household-based scanner data for the two most recent years available from 18 markets covering all nine U.S. census regions.
 - c. Analyze trends on sales price (dollar per pound), volumes (pounds) and market shares of major aquaculture products.
 - d. Prepare fact sheets that summarize price and sales volume data for catfish, crawfish, clams, and shrimp as well as for competing products for distribution to industry stakeholders through extension mechanisms.

2. Identify factors affecting a) trends in prices and sales volumes and b) consumption of fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products.
 - a. Estimate retail pricing models for various fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products based on store level data.
 - b. Estimate retail sales response models for various fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products based on store level data.
 - c. Estimate disaggregated demand functions for various fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products using discrete-choice models based on panel data.

3. Measure competitive position and substitutability of frozen farm-raised catfish, clam, and shrimp products with other seafood products, with an emphasis on imported products.
 - a. Estimate cross price elasticities of various seafood products consumed in the U.S.
 - b. Model consumer demand for type, form, and package size

- c. Construct policy analysis matrices (PAM) and estimate domestic resource costs (DRC) for various aquaculture products of the southern region of the U.S.

ANTICIPATED BENEFITS

Seafood retailing in the United States (U.S.) is carried out via two chief outlets: restaurants and grocery stores. There has been no major study attempting to understand the seafood grocery sector at the national level in the U.S. The grocery sector needs to be analyzed in greater depth in order for seafood businesses to succeed in these times of rapid market change. Increased understanding of trends in supermarket sales of seafood and fish has potential to assist the U.S. aquaculture industry to refine marketing strategies and targets. National scanner data are being used for this study since they contain details of the quantity, price, and hence expenditure, on products sold in a grocery market. They also provide information on characteristics of the products sold per daily/weekly/monthly/or higher frequency and consumers' characteristics, and therefore are a rich source of market information. The Project team has procured scanner data from the A. C. Nielsen Company, and has been analyzing these data and providing customized market reports to seafood companies in the U.S. The total value of these reports provided to industry (at no cost to them) over the past two years was \$5.4 million.

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

Objective 1. *Compile historical data on retail price and sales volumes of major aquaculture species and competing products in key cities and regions in the U.S.*

Sub-Objective 1a. *Convene a project planning meeting.*

University of Arkansas at Pine Bluff, Texas Tech University, Auburn University, and University of Florida

A meeting was held on November 17, 2009 with all project participants attending. Project stakeholder's expectations, project objectives and methods, sources of national scanner data and characteristics of data, matching data requirements and sources, project methodology, and work plan were discussed. The project team decided to purchase a national database from A.C. Nielsen for the recent five years, and considered Information Resources Inc. as an alternative source. Household consumption data using Consumer Expenditure Survey of the Bureau of Labor Statistics, and the USDA National Nutrient Database for Standard Reference were identified as sources for matching data. The University of Arkansas at Pine Bluff was entrusted with the task of obtaining these data.

Sub-Objective 1b. *Procure store-level scanner data for the most recent 5 years and household-based scanner data for the two most recent years available from 18 markets covering all nine U.S. census regions.*

The University of Arkansas at Pine Bluff

Year 1

The University of Arkansas at Pine Bluff (UAPB) procured the household consumption data from the Consumer Expenditure Survey (CES) of the Bureau of Labor Statistics (BLS). The CES data for the years from 2004 to 2008 was obtained in the form of compact discs (CDs) from the BLS. The CES is the most comprehensive and detailed U.S. data source for analyzing demographic effects on household consumption. It collects data on expenditure, income and various household characteristics. It includes two types of survey procedures: the quarterly Interview survey and the weekly Diary survey. Information

from approximately 5,000 households is available in each of these surveys. The interview survey collects information pertaining to expenditures on housing, household durables, apparel, transportation, health care, insurance and entertainment. The Diary survey collects information on weekly expenditures on frequently consumed goods like food and beverage, tobacco, personal care products and nonprescription drugs and supplies. In addition, demographic and family characteristics of each consumer unit (CU) are collected. There are five main data files in CES. These are the Consumer Unit Characteristics and Income (FMLY) file, the Monthly Expenditures (MTAB) file, the Detailed Expenditures (EXPN) file, the Income (DTAB) file and the Imputed Income (DTID) file. Overall these files provide information such as age, gender, race, marital status, education and relationships amongst the members of the CU.

Next, the nutritional characteristics of the relevant products were collected from the USDA National Nutrient Database for Standard Reference. Among the four aquaculture species under study in this project, only the information on crawfish is not available. This will be collected from scientific references and other possible public databases. UAPB procured store-level scanner data from the A. C. Nielsen Company following an opening bidding process; the dataset is composed of weekly data covering 52 U.S. markets for the last 5 years, ending on June 12, 2010. The A.C. Nielsen data category reflects the “department” or physical layout of the typical supermarket and divides food-at-home items into different departments: dry grocery, frozen foods, dairy, deli, packaged meats, and perishables. The store-level database purchased from A.C. Nielsen Inc. contains information for all fish/seafood products in “dry grocery” and frozen food categories. The fish and seafood within the “dry grocery” items include products in canned, shelf-stable, and paste forms. The frozen seafood includes all frozen and chilled fish and seafood available in both prepared and unprepared forms found in refrigerated and frozen sections. The term ‘frozen’ as defined by A.C. Nielsen Inc. includes all chilled/frozen products having Universal Product Codes (UPC) but does not include random weight (or loose) fresh products that have no UPC codes.

Year 2

The UAPB team analyzed the A.C. Nielsen homescan dataset covering five markets, namely Chicago, Houston, Miami, Memphis, New Orleans-Mobile for a five year period from 2007-2008 to 2009-2010. The dataset was comprised of information on buyers’ socio-economic and demographic characteristics (such as household income, age of household head and number of household member), and all the fish/seafood purchases they made during a year (including quantity of product purchased, price paid, date of purchase, and various product attributes). The UAPB team was able to group the households into three income categories (“higher-income”, “lower-income” and “poverty-threshold”) based on the yearly weighted average poverty threshold measured by the U.S Census Bureau. The “lower-income” group refers to households with income at or below the 130% of poverty line, while the “higher-income” group with income above the 130% of poverty line. The total number of households included in the dataset for 2007-2008, 2008-2009 and 2009-2010 are 3427, 3487 and 3655, respectively. The average household size did not vary much over the period and across the markets, with an average of 2.53, 2.83, and 2.65 persons for the “higher-income”, “lower-income”, and “under-poverty-threshold” groups, respectively.

Results show that the average household expenditure on fish/seafood increased over the period of 2007-2008 to 2009-2010 in all the five markets studied, with the highest increase found in the “lower-income” group (approximately of 20%) followed by the “higher-income” group (9%) and the “poverty-threshold” group (6%). Frozen/chilled finfish has become more popular among the households within the surveyed markets. In particular, the average household expenditure on unbreaded finfish products increased substantially, by 75% in the “poverty-threshold” group, 21% in the “lower-income” group and 22% in the “higher-income” group. Top five unbreaded finfish products based on average household expenditure on fish products are shown in Table 1, along with information on number of purchasing households and average expenditure per household on the listed products. As expected, the average fish/seafood

Table 1. Top five preferred unbreaded species in Chicago, Houston, Miami, Memphis, New Orleans-Mobile markets, A. C. Nielsen data, 2007-08 to 2009-10.

Income group	Rank	Year 2007-2008			Year 2008-2009			Year 2009-2010		
		Species	% of HH consumed the species	Expenditure (\$) per consuming HH per annum	Species	% of HH consumed the species	Expenditure (\$) per consuming HH per annum	Species	% of HH consumed the species	Expenditure (\$) per consuming HH per annum
Higher-income	1	SALMON	12.58	20.58	SALMON	13.51	20.37	SALMON	13.68	20.82
	2	TILAPIA	12.02	16.57	TILAPIA	15.08	18.12	TILAPIA	16.25	16.21
	3	ORANGE ROUGHY	2.83	19.95	CATFISH	3.15	19.57	CATFISH	3.01	20.67
	4	CATFISH	2.48	20.01	COD	2.95	14.82	COD	3.56	13.65
	5	COD	2.80	14.35	ORANGE ROUGHY	2.06	20.67	FLOUNDER	4.40	10.49
Lower-income	1	TILAPIA	3.30	15.47	TILAPIA	3.36	18.46	TILAPIA	4.95	14.36
	2	SALMON	2.63	14.03	SALMON	2.29	16.29	SALMON	3.17	13.53
	3	CATFISH	0.79	20.25	CATFISH	0.86	19.21	CATFISH	0.93	24.51
	4	WHITING	0.44	26.50	ORANGE ROUGHY	0.46	15.65	COD	0.79	15.72
	5	FLOUNDER	0.70	10.97	FLOUNDER	0.75	9.27	FLOUNDER	1.07	10.02
Poverty-threshold	1	TILAPIA	0.67	11.42	TILAPIA	0.83	14.80	SALMON	0.71	24.73
	2	SALMON	0.35	11.92	SALMON	0.40	18.40	TILAPIA	1.01	13.97
	3	WHITING	0.18	15.44	WHITING	0.11	34.23	CATFISH	0.30	13.44
	4	CATFISH	0.06	28.63	FLOUNDER	0.26	7.40	COD	0.16	14.18
	5	BASA/TRA	0.03	54.18	COD	0.09	15.65	MAHI MAHI	0.08	27.43

consumption increases consistently with increase in income. Salmon and tilapia have remained the two most popular unbreaded frozen/chilled finfish products among all income groups. Consumption of unbreaded frozen/chilled catfish has increased among all income groups. It was a mixed result for breaded finfish products; the average household expenditure increased by 7% for the “lower-income” group, while it decreased for both the “poverty-threshold” group (by 3%) and the “higher-income” group (by 4%).

The average consumption of breaded non-fish products has increased among the “higher-income” (by 10%) and the “lower-income” (by 16%) groups. But the average expenditure per household on all non-fish has decreased over the period by approximately 20% in each of the income groups due to a significant decrease in the consumption of unbreaded forms of products. Shrimp is the most preferred species – in both non-fish and overall fish/seafood categories – across the markets; however, the expenditure per household on unbreaded shrimp has decreased over the period among the “higher-income” group by approximately 18%.

Sub-Objective-1.b. (Supplemental). *Procure store-level scanner data for the most recent 2 years covering 52 U.S. metro markets (exclude Walmart) and an additional most recent 3 years data covering 10 metro markets with Walmart included.*

UAPB procured an additional two years of store-level scanner data from the A. C. Nielsen Company; the dataset is composed of weekly data covering 52 U.S. markets from July 2010 ending on June 12, 2012. Recently, A.C. Nielsen Company has started to cover Walmart in their database. Hence the UAPB team also procured weekly data covering 10 U.S. markets that includes Walmart and other outlets for the last three years, ending on September 1, 2012.

Sub-Objective 1.c. *Analyze trends on sales price (dollar per pound), volumes (pounds) and market shares of major aquaculture products.*

The University of Arkansas at Pine Bluff

Overall Trends in Sales

From 2005-06 to 2009-10, frozen seafood sales in supermarkets increased by an average of approximately 6% per year. Frozen finfish accounted for a significant part of total frozen seafood sales during this period with its share increasing from 39% in 2005-06 to 42% in 2009-10. From 2005-06 to 2009-10, frozen finfish sales in supermarkets increased by 35%. This indicates that frozen finfish sales (in value) are increasing faster than total frozen seafood sales. A list of the top ten best-selling frozen fish over the past five years is provided in Table 2. Tilapia has been the top seller in supermarkets since 2006-07. The position of catfish has improved over the years from eighth place in 2005-06 to fourth place from 2008-09 onwards.

Results indicate that catfish and shrimp saw consistent increasing sales over the last five years (2005-06 to 2009-10), with the former registering high increases; clams had decreased sales in comparison to 2005-06, but the reduction in sales was slowing down; and crawfish sales increased last year (2009-10). Unbreaded shrimp is the most dominant product amongst all the finfish and shellfish frozen products.

Trends in Prices

Breaded catfish products were cheaper than most others, since most of them were sold as breaded nuggets. Shrimp prices remained stable over the years, while there was a marginal increase in breaded clam prices. It is interesting to note that breaded clams and crawfish are priced higher than shrimp.

Table 2. Top ten best-selling frozen finfish species from scanner data from 2005-06 to 2009-10.

Rank	2005-06	2006-07	2007-08	2008-09	2009-10
1	Whiting	Tilapia	Tilapia	Tilapia	Tilapia
2	Tilapia	Whiting	Salmon	Salmon	Salmon
3	Salmon	Salmon	Whiting	Whiting	Whiting
4	Tuna	Tuna	Tuna	Catfish	Catfish
5	Cod	Flounder	Catfish	Flounder	Flounder
6	Flounder	Catfish	Flounder	Cod	Cod
7	Pollock	Cod	Cod	Pollock	Haddock
8	Catfish	Pollock	Pollock	Tuna	Tuna
9	Haddock	Haddock	Haddock	Haddock	Pollock
10	Perch	Orange Roughy	Orange Roughy	Perch	Perch

Catfish, as well as crawfish, clams and tuna, were amongst lower-priced entrée products. Entrée clam prices increased in price over the years and there was decrease in prices of entrée shrimp that could be explained by the introduction of cheaper types of products (like Alfredo) and cheaper package sizes (like 21oz regular entrée). Results also show that average price of entrée crawfish products decreased over the years.

Prices of unbreaded finfish fillets with or without promotion showed that tilapia, basa/tra, pollock, and whiting were less expensive than catfish. Price differences between catfish and unbreaded tilapia fillets became wider after price promotion, but between catfish and basa/tra the differences became narrower after promotion. Crawfish was priced higher than shrimp, while clam prices fell sharply over the last two years (2008-09 and 2009-10).

One key observation from price trends is that the sales performance of the product in a market is positively correlated with the degree of promotional pricing given to that product. This behavior was seen for many products in many markets. Another observation is that there was a tendency to price larger packages at lower unit prices, thereby indicating the presence of “quantity discounts”, for example “economy packs” in the retail sales.

Trends in Product-Specific Sales

Catfish Products

Breaded catfish sales rose in general over the last five years (2005-06 to 2009-10). Breaded nuggets constitute about 88 to 94% of breaded catfish sales with the rest shared between fillet and strips. The most popular packaging size of breaded nugget was 80 oz, followed by 32 oz. For fillet and strips, they were 8 oz and 13 oz respectively.

Catfish in entrée form was not able to penetrate the market. There was a decline in sales of about -25% to -35% annually with respect to 2005-06, with a corresponding decline in market share. It also received a much lower degree of promotion. Amongst nine types of entrée catfish available, only Cajun catfish registered consistent increases in year-to-year sales, raising its share amongst catfish entrées to almost 62% in 2009-10 from 4% in 2005-06.

Unbreaded catfish sales showed impressive year-to-year growth. Nuggets and fillet constitute about 99% of unbreaded catfish sold. Nuggets still formed the largest selling product form, though their share decreased by around 15% over the years. The share of fillet consistently increased during the same period

by approximately 14%. Amongst nugget package sizes, 80 oz (5 lb) and 32 oz (2 lb) were the most prevalent, capturing 40 to 48% of unbreaded catfish sales. Amongst fillet packages, there was an increase in share of 40 oz packages, having replaced 64 oz packages as the most popular package size in the last two years (2008-09 to 2009-10).

For breaded catfish products, New Orleans/Mobile is the largest market and accounts for about 11 to 14% of the sales during 2005-06 to 2008-09, while its share increased sharply to 44.6% during 2009-10. San Antonio and Memphis are important markets for breaded catfish strips and fillets respectively. New Orleans/Mobile is the only city where entrée catfish sales are on the rise with Cajun catfish mostly sold there.

Memphis is also the largest market for unbreaded catfish, and there are three Pacific cities, Los Angeles, Sacramento, and San Francisco, in the top-5 markets. Southern markets are still important as demonstrated by the presence of cities like Little Rock, San Antonio, Houston, Dallas and New Orleans/Mobile.

Crawfish Products

Breaded crawfish is not a major product in terms of sales volume, and its sales mainly take place in the Southern cities like San Antonio, Houston and Dallas. There are about 20 different types of entrée crawfish products of which the top-5 account for about 65 to 86% of all crawfish entrées. The share of entrée crawfish in total entrée seafood market has almost doubled over the last five years.

Amongst unbreaded crawfish products, crawfish tail meat constitutes 76 to 94% of all unbreaded crawfish sales. Sales of crawfish tail meat dropped over the last five years, while whole unbreaded crawfish and crawfish pieces increased during the last two years. Amongst package sizes, crawfish tail meat packages of 12 oz (decreasing share) and 16 oz (increasing share) account for about 90 to 94% of total unbreaded crawfish sales.

Amongst the major markets for entrée crawfish, New Orleans/Mobile tops the list but its share of total entrée crawfish sales declined considerably over the years from about 40% in 2005-06 to 14% in 2009-10. Sales in Houston, Dallas, Tampa and Washington D.C. increased during the same period. The top-20 cities account for about 90 to 92% of sales. It is interesting to note that entrée crawfish products, though sold mostly in southern U.S. cities, saw a sales growth in non-traditional crawfish markets like New York, Detroit, Philadelphia, New England cities, and cities in Ohio.

New Orleans/Mobile is the most dominant market for unbreaded crawfish with about 70% consumption. Houston has about 14% of the share, followed by the other two Texas cities of Dallas and San Antonio with about 3 to 4% market share each. Memphis has about 1.5 to 2% share. Thus, these five cities together account for about 90 to 95% of all crawfish consumed through retail supermarkets.

Clam Products

There are five product types that are popular- Crunchy clam, regular clam, Crispy tender, Stuffed and Fried Crunchy. The first two types accounted for about 65%, and the first three types accounted for about 85% of the breaded clam products sales. Smaller package sizes (less than 12 to 14 oz) were observed to be more popular. Amongst 12 types of entrée clam products, "Regular clam entrée" have the largest share of 87 to 90%. Amongst unbreaded clams, whole unbreaded clams account for about 76 to 94% of these products, thus being the most prevalent product form. Whole clams packed in 50 oz packages have become the most important package sizes, with their shares rising to almost 70% of the total unbreaded clams sold.

For breaded clams, New York and Boston are the largest markets, each accounting for about 10 to 15% of sales. Top-5 cities account for about 40 to 45% of sales, including Hartford/New Haven and Boston amongst. New York alone consumes about 30 to 33% of entrée clam products, thus making it largest market for the products. In the last two years, Philadelphia alone consumed about 50% of all the unbreaded clams sold. Sales in Raleigh/Durham and Charlotte have also increased in the last two years.

Shrimp Products

Whole breaded shrimp were observed to be the most prevalent products amongst breaded shrimp. In terms of sales growth, whole breaded shrimp in 10 oz, 10.5 oz, 14 oz, 20 oz, and 32 oz (2 lb) packages have sold well. There are more than 600 different types (with respect to dressing style, method of pre-treatments, etc.) of unbreaded shrimp products available in the U.S. market. Uncooked types and cooked types have almost equal share.

For breaded shrimp, there are no single markets with a very high share of total sales. The 15 largest markets together have only about 25% of total sales, with the top-2 cities (i.e., Washington, DC and Chicago) consuming about 5% each. New York is the top market for entrée shrimp products, with a share of 7.5 to 8.4% of all entrée shrimp sold. New York and Philadelphia are the largest two markets for unbreaded shrimp products, while Miami, Tampa and Orlando have also registered high growth amongst the top-10 cities.

Year 3

Comparison of Seafood Market Trends in Recent Scanner Data (2010-2012) with and without Walmart Stores

The UAPB team procured additional store-level scanner data, including data from Walmart stores, to better analyze the demand for major aquaculture species and the competing products in key cities and regions of the United States. This new data set with information from Walmart stores composed of weekly data from January 24, 2009 to September 1, 2012 for two different geographical levels: total U.S. (National) and 8 U.S. markets. The UAPB team analyzed how the market trends differ between with and without inclusion of Wal-Mart sales. In the subsequent discussion, the terms “Market- Other” and “Market-WalMart” are used to denote the “dataset without Wal-Mart sales” and “dataset with Wal-Mart sales”, respectively. Data are aggregated at every four weeks.

Comparison of Trend in Sales Volume and Value between “Market-Other” and “Market-WalMart”

Both scanner datasets show growth of supermarket sales of unbreaded frozen/chilled finfish products over the past 2 years. From 2010-2011 to 2011-2012, frozen seafood sales (in value) in supermarkets increased by approximately 10% and 6% per year for “Market-Other” and “Market-WalMart”, respectively. In 2010-11, the top ten best-selling frozen/chilled finfish species (in value) were almost identical in both the markets except that orange roughly was found important in the “Market-Other”, while tuna in the “Market-WalMart”. Tilapia was the top seller in both the markets during 2011-12, and its share in the total sales of unbreaded frozen/chilled finfish products was found to be higher in the “Market-WalMart”. The position of catfish weakened during 2011-2012 last year in both the markets, and this was likely resulted from the increased share of swai, bocourti, basa and pangasius that almost doubled of the 2010-2011 level.

Sub-Objective 1.d. *Prepare fact sheets that summarize price and sales volume data for catfish, crawfish, clams, and shrimp as well as for competing products for distribution to industry stakeholders through extension mechanisms.*

The University of Arkansas at Pine Bluff

Upon advice of key industry representatives, the decision was made not to form a single industry advisory panel, particularly given the competitive nature of processors who will make best use of the results of this project. Instead, a combination of formal presentations to trade associations and individual meetings and consultations has been held. Formal presentations have been made at the Catfish Farmers of America annual convention and at the annual meeting of the U.S. Trout Farmers Association at the Aquaculture America 2011 meeting. These presentations focused on explaining to industry members what the data are, what the possibilities for using the data are, and offering to run customized reports for individual companies. The U.S. Trout Farmers Association has also requested a follow-up presentation at their annual fall meeting on September 29, 2011. Individual meetings were held at the request of 6 catfish processing companies to further discuss the data and the type of reports that can be run with the data. Written reports have been sent to 19 catfish processing companies and detailed follow-up reports to 6 catfish processing companies at their request.

Objective 2. *Identify factors affecting a) trends in prices and sales volumes and b) consumption of fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products.*

Sub-Objective 2.a. *Estimate retail pricing models for various fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products based on store level data.*

University of Florida

The goal of this sub-objective was to generate information from revealed preference data (i.e., observed market behavior) on individual product attributes for various types of fish and shellfish products sold in the U.S., with an emphasis on information on products sourced from the Southeast and from culture operations.

A retail price response model and sales response model were previously developed for catfish products only. The effects of product characteristics (product type, form, packaging size, brand identity) and product promotion were modeled. To augment this analysis (e.g., for other species or species groups and to consider other product attributes), an approach was utilized that assumes that retail prices paid by consumers reflect the total of the values of individual product attributes. The approach estimates “implicit prices” or market values of the attributes or characteristics that are commonly used to generate market information. These implicit attribute prices identify premiums and discounts associated with specific attributes and can be beneficial to harvesters/growers, processors and retailers as they make production, processing, packaging and pricing decisions.

Implicit retail prices were estimated for frozen unbreaded finfish and shellfish sold in the U.S. Southeast. The “frozen” category included all frozen and chilled seafood available in both prepared and unprepared forms that are usually found in refrigerated and frozen sections of supermarkets. “Seafood” includes 84 freshwater and marine finfish and shellfish species (or species groups). The analysis excludes shrimp, a large volume and relatively generic product, to better focus on lesser studied species and product attributes.

The product characteristic and form attributes include variables that identify species, flesh color, geographic origin and level of processing. The packaging attributes include package size, whether it is a

store branded product (versus name brand), and whether the product was registered in the U.S. The promotional information indicates whether the promotion involved a change in price (e.g., price increase, small price decrease, or large price decrease).

Two hedonic models were initially estimated: one for finfish and one for shellfish (separate models are necessary since some of the attributes are different). To better understand the markets for these products, the data are disaggregated to allow for the inclusion of attributes that are only available for a subset of products. For example, approximately 70% of the observations in the finfish model are fillets and approximately 50% are categorized as “regular.” By examining the data and models for these groups separately, we are able to explain the seafood sales in the market and obtain more robust estimates of implicit prices and promotional strategies.

In addition to the hedonic analyses, the monthly AC Neilson data is available five years (July 2005 through June 2010) with seafood products grouped into 19 product categories. Four of these product categories include clam products: canned, entrees, breaded and unbreaded products. In 2010 (July 2009 through June 2010), these clam products accounted for over \$59 million in sales at the retail level (approximately 2% of total seafood product sales). By category, canned, entree, breaded and unbreaded clam products sold \$40, \$12, \$4, and \$3 million in 2010, respectively. The number of clam products included in each product category was 137 canned products, 37 unbreaded products, 27 entrée products and 16 breaded products. The unbreaded product category included the most detail, especially with respect to species. As a result, this summary will focus on hard shell, little neck and mahogany clam products, as those types of clam products are of importance to the Florida industry.

Findings revealed expected premiums and discounts for traditional attributes (size, species, and form). In general, large discounts were estimated for low-valued products versus non-price promotions for higher-valued species, with interesting implications for distributors and retail outlets.

Frozen Unbreaded Fish and Shellfish (weekly, June 2007 through June 2010)

- In the U.S. finfish dataset, 11 groups of fish species had some products labeled as “wild.” Of those species, 14% of the weekly observations were products with “wild” on the label and the wild label was found to command price premiums of 5.9% to 43.7% depending on the species.
- In the shellfish dataset, nearly one-third of the weekly observations were products labeled as “imported” and the imported label was found to increase price 5.9% in the case of one species (lobster) but decrease price for four other species groups from 11.0% to 34.1%.
- Across both product types (i.e., unbreaded frozen fish and shellfish), promotional activities resulted in products being sold at a discount, from 15.2% to 29.7% when all products were on promotion.
- The retail prices for only two species groups (scallops and lobster) declined after the Deepwater Horizon oil spill, which occurred in late April 2010, while the prices for 10 others increased, but only marginally (i.e., from 3.1% to 9.6%).
- Products sold under a retailers’ own label (grocery store brand) were found to substantially reduce the price of shellfish products but slightly increase the price of finfish products; only the latter result concurs with previous studies.

Hard Shell, Little Neck and Mahogany Clam Products (monthly, June 2005 through June 2010)

- Eight products sold by six different companies are labeled as either “hard shell,” “little neck” or “mahogany.” Only one company, J.P.’s Shellfish Company, sells mahogany clam products. Two companies, Cherrystone Aqua Farms and Ocean Rich, sell little neck clam products. The Cherrystone Aqua Farms clams are labeled as “shell-on.” Three companies, Mar-lees Seafood Inc., Pana Pesca and Sysco sell hard shell clam products.
- Clam products labeled as mahogany or little neck were introduced during 2008. Since then, little neck products have experienced the most growth, selling 5,000 units in 2009, and over 50,000 units in

2010. The majority of this growth is from the sale of a one pound package by Ocean Rich Distributors (not indicated, but believed to be shell-off), with 1,900 units sold in 2009 and 47,000 units sold in 2010. Mahogany clam product sales have grown by 27% during the same time period, which indicates strong market demand for clam products similar to those cultured in Florida.

- Price comparison is difficult due to different package measurements. All comparison must be done at the package level because some products are sold in counts, while others are sold in ounces. For example, Cherrystone Aqua Farms sells shell-on Little Neck clams in counts of 50. These clam products have declined in price from \$23 per package in 2008, to \$14 per package in 2010. However, at \$14 per package, this product still sells at a price nearly triple that of hard shell and mahogany clam products. When J.P.'s Shellfish Company introduced mahogany clam products in 2008, they sold at an average price of \$8 per package. Since then, this product has declined in price to around \$5 per package, much better positioned to compete with hard shell clam products with an average package price of \$5. However, all hard shell clam products are sold in a 16 oz package, while mahogany clam products are sold in a 32 oz package. The mahogany products cost approximately half that of hard shell products, when measured in dollars per ounce.

Sub-Objective 2.b. *Estimate retail sales response models for various fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products based on store level data.*

The University of Arkansas at Pine Bluff

A retail price response model and sales response model were developed for catfish products. The effects of product characteristics (product type, form, packaging size, brand identity), consumer characteristics (average family size, racial/ethnic background, household income, food-related expenditures, region), and product promotion were modeled.

As expected, the price of unbreaded catfish had significantly negative effects on sales volume. Effects of prices of unbreaded tilapia, basa/tra, salmon, cod, and pollock on unbreaded catfish volume varied with the region (Table 4). In the South, Northeast and Mid-West regions, tilapia had positive cross-price elasticities. Thus, in these regions, catfish sales would rise with increases in tilapia prices. This relationship is a characteristic of substitute products. However, in the West, tilapia has negative cross-price elasticities indicating that tilapia is a complement of catfish. These findings imply that frozen tilapia and catfish may be in the same market in these regions. Cross-price elasticity of tilapia in the South region was positive, but was negative in the West, Mid-West, and Northeast regions. This result implies that, in the South region, breaded products of catfish and tilapia are substitutes. The model indicated catfish retail price and sales vary with region; so, marketing efforts should take this variation into consideration. Substitutability and complementarity for catfish with other finfish products also vary with the region. Retail level non-price competition strategy should be considered as an effective tool to increase sales in U.S. supermarkets. The model also indicated the positive influence of promotional pricing on sales volume but a negative influence on retail price.

	Northeast	South	West	Mid-West
Tilapia	0.499	0.499	-0.051	0.481
Basa / tra	-0.165	-0.165	0.506	-0.165
Salmon	-0.902	-0.902	-0.902	-0.836
Cod	0.000	0.017	0.000	0.000
Pollock	-0.274	-0.274	-0.550	-0.274

Sub-Objective 2.c. *Estimate disaggregated demand functions for various fresh and frozen farm-raised catfish, crawfish, clam, and shrimp products using discrete-choice models based on panel data.*

The University of Arkansas at Pine Bluff

Factors affecting market demand for these aquaculture products were estimated using an Inverse Almost Ideal Demand System (IAIDS). The IAIDS model was modified to account for the effects of season, deepwater horizon oil spill (DHOS), and lagged consumption. The distribution of tilapia and catfish is not similar across the markets in the U.S. and studying substitutability of tilapia for catfish in markets where catfish is having significant market shares (e.g., South and Midwest region of the U.S.) can produce different results. Catfish, tuna, flounder, cod, clam, scallop and squid show seasonality in their marginal consumption value (price).

Region-wise market interaction between different white fish modeled suggested many marketing strategies for the domestic catfish industry. In the Midwest region, catfish is a quantity-substitute to tilapia, and tilapia is a quantity-complement to catfish. The other white fish products (cod, flounder, Pollock, and whiting) are weaker quantity substitutes for catfish in the Midwest region as compared to catfish. Therefore, offering customers high value at a low price and/or short-term reduction in the product's price in the Midwest region of the U.S. can benefit the catfish industry. In the West region cod and whiting are substitute products for catfish in all seasons. Catfish substitutes for flounder in all seasons, and for cod, tilapia and pollock from November to April. In the Northeast region, catfish demand is own-price inelastic with no stronger substitutes except for tilapia from November to January. Therefore, the catfish industry can increase its revenue by increasing supply of unbreaded frozen catfish products to the Northeast region. Own- and cross-price flexibility estimates show that in the Southern region, price strategies would not help the U.S. catfish industry. However, non-price marketing strategies like non-price promotion (e.g. product placement in the stores), country-of-origin labeling, and generic advertisement would benefit the catfish industry.

Catfish demand is the highest in the Southern region followed by the Midwest, and is the lowest in the Northeast region of the U.S. Catfish demand is the highest during the months of November to January. Tilapia demand is the highest in the West region, while demand for pollock is the lowest in the Midwest region. Demand for frozen whiting is the highest in the Northeast and is the lowest in the South region.

Amongst unbreaded products shrimp and crab, and crab and crawfish were quantity substitutes. Seafood consumers who consumed a product in the previous week would prefer to consume its substitute product (for example crawfish and crab, squid and perch, lobster and squid, and scallop and clam) in the current week. Clam products exhibit seasonality in sales.

Objective 3. *Measure competitive position and substitutability of frozen farm-raised catfish, crawfish, clam, and shrimp products with other seafood product with an emphasis on imported products.*

Sub-Objective 3.a. *Estimate cross price elasticities of various seafood products consumed in the U.S.*

Texas Tech University and Auburn University

One of the biggest challenges facing American aquaculture industries remains the high levels of fish and shellfish imports. According to NOAA, the U.S. imports approximately 84% of its seafood needs, up from 63% ten years ago. Most consumers want processed fish/shellfish products and not live product, putting domestically produced and processed products in direct competition with less expensive imported aquaculture and wild-caught fish products. Therefore, accurate knowledge of demand and substitution among domestic and imported aquaculture products is critical to the U.S. aquaculture industry as well as

to public policy evaluation. At the production, processing and marketing levels, understanding consumer demand is a helpful decision-making tool in determining investment and production capacity planning, production allocation, sales, and advertising and promotional activities.

An Almost Ideal Demand System (AIDS) approach was used to estimate the substitutions between fish and shellfish products and assess the impact of promotional activities on sales of fish and shellfish products in the U.S. The objective was to shed light on the substitutability between specific aquatic products produced in the U.S., namely catfish, crawfish, and clams with other potentially competing seafood products, such as imported shrimp, tilapia, and salmon. Additionally, another objective was to provide promotional elasticities that can be used to assess the impact of the promotional activities and developing future marketing strategies.

The estimation of the AIDS model was used to derive demand price elasticities, which are the responsiveness of retail buyer's change in quantity demanded to changes in product price, for aquaculture products (Table 5). For the price elasticities, all the own-price elasticities are negative, as expected, and statistically significant, except for the case of crawfish. In addition, the demands for the considered fish/seafood categories are inelastic. Price inelasticity means total revenue would increase when increasing the price of the product. The results indicate the demand for salmon is the more elastic of the inelastic species, followed by shrimp, clams, tilapia, and catfish. A 10% increase in salmon price would decrease its sales by 9.8%; while for catfish, the same price increase would decrease the sales by only 4.8%. This indicates that American consumers show some "loyalty" towards domestically produced catfish compared to the imported categories, such as shrimp, tilapia, and salmon.

In terms of substitution, it is worth noting that shrimp has all other products as its complement, though they are weak complements. In contrast, shrimp is a strong complement for crawfish (-0.89), tilapia (-0.65), and catfish (-0.59). In fact, a 10% increase in the price of shrimp will reduce the sales of crawfish, tilapia, and catfish by 8.9%, 6.5%, and 6.0%, respectively. Results show that American consumers consider catfish as a strong substitute for tilapia, probably because both have white flesh coloration and similar texture; while catfish and salmon are complements as salmon flesh being pink/red colored is seen in a different light from white colored catfish flesh. Hence, an increase of 10% in the price of tilapia will increase catfish sales by 7.2%; while an increase of 10% in the price of salmon will reduce catfish sales by 3.8%. In contrast, a 10% increase in the catfish price will increase tilapia sales by only 1.5%, suggesting tilapia is not a strong substitute for catfish.

The results for the expenditure elasticities show that, on average, American consumers consider catfish, crawfish, shrimp and tilapia as luxury goods (elasticity > 1); while they consider clams and salmon as necessity goods (elasticity < 1). For instance, an increase of 10% in the consumer's income would increase consumption of catfish, crawfish, shrimp, and tilapia by 11.2%, 10.1%, 11.1%, and 10.4%, respectively. The same income increase would induce a 9.08% increase in the consumption of clams and only a 5.47% increase in the consumption of salmon.

On average, shrimp are the most promoted product by retailers, followed closely by tilapia. In fact, more than 58% of the sales of shrimp are realized using some sorts of promotion efforts such as price reduction, feature, and display. The other imported fish category that is heavily promoted is tilapia, with more than 57% of its sales having been realized in association with promotional activities. For salmon, there were more than 41% of sales occurring with some type of promotion. Catfish promotion level was similar to salmon, at more than 38% of sales having promotions. Promotion elasticities are positive and statistically significant for crawfish, clam, and shrimp. For instance, a 10% increase in the volume sold under any type of promotion would increase budget share by 0.12%, 0.08%, and 0.01% for crawfish, clam, and shrimp, respectively. For tilapia and salmon, which are primarily imported products, promotional

activities have a negative and statistically significant impact on the budget share. For catfish, promotional activities have a positive but not statistically significant impact on budget share.

	Catfish	Crawfish	Clams	Shrimps	Tilapia	Salmon
Catfish	-0.4804 (-3.26)	-0.0590 (-0.79)	-0.3283 (-4.27)	-0.5985 (-5.55)	0.7229 (7.29)	-0.3784 (2.51)
Crawfish	-0.1788 (-0.77)	-0.1443 (-0.60)	0.5081 (3.03)	-0.8884 (-5.65)	0.3898 (2.27)	-0.6939 (-2.45)
Clams	-0.2900 (-4.20)	0.1489 (3.04)	-0.7901 (-5.16)	0.0803 (0.58)	-0.6601 (-4.91)	0.6029 (3.89)
Shrimps	-0.0217 (-5.15)	-0.0121 (-5.80)	-0.0031 (-0.51)	-0.8728 (-28.16)	-0.1324 (-6.68)	-0.0629 (-5.83)
Tilapia	0.1463 (7.36)	0.0249 (2.23)	-0.1498 (-4.97)	-0.6472 (-6.22)	-0.6905 (-8.79)	0.2817 (5.28)
Salmon	-0.0501 (-2.13)	-0.0313 (-2.17)	0.1198 (4.45)	0.1242 (3.13)	0.2704 (6.72)	-0.9797 (-16.85)
Expenditure	1.1216 (15.40)	1.0076 (10.47)	0.9079 (9.90)	1.1050 (14.61)	1.0345 (13.83)	0.5466 (19.90)
Promotion	0.0007 (0.50)	0.0117 (4.04)	0.0082 (12.55)	0.0014 (14.61)	-0.0029 (-6.77)	-0.0051 (-12.66)

*Figures in parenthesis are t-test values

Overall, results indicate that the demand for all categories considered are inelastic, suggesting that consumers are less responsive to price changes than previously thought. Interestingly, the consumer price responsiveness for catfish is lower compared to the imported categories of shrimp, tilapia, and salmon. This implies that American consumers can “tolerate” an increase in the catfish price. In addition, American consumers consider catfish as a strong substitute for tilapia; while tilapia, though a substitute for catfish is not a strong one. One strategic implication for catfish producers/processors is to survey tilapia prices and react appropriately. For instance, if tilapia prices increase by 10%, all else held constant, catfish producers/processors could keep the prices unchanged and “enjoy” more than 7% increase in the sale of catfish. In contrast, if they match the price increase, the catfish sales will drop due the own-price effect (4.80% in this case) and loss of sales to tilapia (about 1.50%). However, any price decrease in tilapia should be matched by catfish producers/processors. In fact, if tilapia prices decrease by 10% and catfish producers/processors do not react, catfish sales will be reduced by more than 7.23%. If they match the price decrease (10%), their sales will increase by more than 4.80% due to own-price responsiveness plus an additional 1.50% due to substitution from tilapia. This would bring the decrease in sales to only 0.93%. In addition, this study shows that even though shrimp and salmon have the largest market values in the U.S. seafood market, tilapia is the species that has the most negative effect on domestic aquaculture products, e.g. the US farm-raised catfish industry. Data show that imported products are heavily promoted by retailers; while domestic products lag behind.

University of Arkansas at Pine Bluff

Frozen and chilled seafood marketing in grocery stores has undergone substantial transformation as a result of the introduction of value-added and convenient products into the category. However, it is not yet

clear whether consumers perceive these value-added seafood products to be substitutes for the traditional unbreaded products. We have modeled demand for frozen seafood in the U.S. within the linear approximate almost ideal demand system (LA-AIDS) framework using market-level monthly retail scanner panel data. We have estimated the own price elasticity (percentage change in demand for a product due to one per cent change in price of the same product), cross-price elasticity (percentage change in demand for a product due to one percent change in price of another product) and expenditure elasticities (percentage change in demand due to one percent change in expenditure) of demand for various fish/seafood categories. Our emphasis has been on the demand for the three aggregate frozen seafood categories, namely breaded products, seafood entrées and unbreaded products, and also on the demand for these categories when disaggregated as finfish and shellfish.

Using market-level retail scanner data we find that the unbreaded products, which are less value-added products, have a dominant share of about 65% of total frozen seafood. Unbreaded shellfish alone account for about 47% of all frozen/chilled seafood. Table 6 presents responsiveness of demand for seafood products due to a) changes in expenditure (expenditure elasticities), and b) changes in price (price elasticities) with and without taking into account the income effect of price change. Uncompensated price elasticity covers both the income and substitution effects of price change, while the compensated elasticity only captures the substitution effect of price change. The responsiveness to changes in own-price of unbreaded shellfish decreased in absolute value due to the removal of the income effect; this result indicates a substantial expenditure/income effect of the price changes of these products. Overall, although the degree of substitution decreased between most products after income compensation, but still indicate net substitutability. Considering the dominant share of unbreaded products in the frozen seafood section, their higher responsive to expenditure, and the prediction of increased seafood consumption, these products have strong potential for further market dominance.

The two value-added product categories (breaded and entrée) were mutual substitutes. Results imply that consumers do not yet consider value-added products to be strong substitutes for the less-prepared unbreaded products, whereas not vice versa. Therefore, processors and retailers of value-added products may attempt to differentiate their products with respect to unbreaded products to reduce competitive effects.

Table 6. Demand elasticities for disaggregated finfish and shellfish products

Price of	Expenditure elasticity	Uncompensated price elasticity						Compensated price elasticity (without income effect)					
		Dependent variables*						Dependent variables*					
		BFF	BSF	EFF	ESF	UFF	USF	BFF	BSF	EFF	ESF	UFF	USF
BFF	0.634	-1.126	0.629	0.327	0.313	0.018	-0.082	-1.257	0.621	0.307	0.289	0.008	0.022
BSF	0.766	0.199	-1.882	0.123	0.114	0.010	-0.009	0.150	-1.891	0.098	0.114	-0.002	0.117
EFF	0.461	0.100	0.118	-1.002	-0.018	0.008	-0.051	0.070	0.112	-1.017	-0.017	0.001	0.024
ESF	0.413	0.101	0.115	-0.023	-0.898	-0.074	-0.035	0.074	0.110	-0.036	-0.398	-0.081	0.033
UFF	0.904	0.064	0.057	0.100	-0.111	-1.030	-0.017	0.005	0.045	0.071	-0.109	-1.045	0.132
USF	1.347	0.118	0.197	0.014	0.187	0.164	-1.153	0.031	0.180	-0.030	0.186	0.141	-0.932

*BFF= Breaded finfish, BSF = Breaded shellfish, EFF = Finfish entrée, ESF = Shellfish entrée, UFF = Unbreaded finfish, USF = Unbreaded shellfish

Year 3

Seasonal and Spatial Variations in Demand for and Elasticities of Fish Products in the United States

Analyzing seasonally- and spatially-varying demand elasticities provided important information to seafood producers and marketers as well as policy makers. The effects of season and space on demand (translation effects) and price as well as expenditure elasticities of demand (scaling effects) for 13 finfish species in the U.S were estimated. The market-level scanner data for 52 U.S. markets were used. Table 7 showed seasonal variations in cross-price elasticities (that is, % change in the quantity of demand for one species due to one % change in the price of another fish species) that tilapia is a strong substituting product for catfish. However, spatial analysis reveals that their relationship varies between complementarity and substitutability. Results suggested that not only the quantity demanded, but also the demand elasticities vary across species, seasons and geography; not only does the degree of competition among finfish products vary considerably over space, but substituting products themselves change. Study results show that tilapia is a strong substitute for catfish in all seasons, but not vice versa. While tilapia is a substitute for catfish in the East North Central, New England, Pacific divisions, it has a complementarity for catfish in Mountain, West North Central and East South Central divisions. Other substitutes for catfish are perch, flounder, and cod (East South Central), tilapia and whiting (New England), salmon and tilapia (East North Central), whiting (West North Central) and tilapia (Pacific). The analyses highlighted the importance of studying consumer demand behavior at species level, across seasons and geography, particularly as it sheds important light on some important policy issue such as the potential substitution between catfish and tilapia in the U.S. markets.

Sub-Objective 3.b. *Modeling consumer demand for type, form, and package size*

Texas Tech University

Manufacturers/processors often offer food products in more than one package size, allowing consumers more choices on a given shopping experience. This has implied an expansion of the number of fish and seafood products in the last two decades. For example, in the shrimp category, there are more than 400 unbreaded shrimp brands sold under different package size. In addition, considerations such as health issues, family size, and the number of children in the household have triggered more product differentiation. In the case of fish and seafood products, this differentiation operates in three dimensions:

1. Type: Fish and seafood products come under different types: entrée products, breaded fish and seafood, unbreaded fish and seafood, and canned products;
2. Form: Fish and seafood come under different forms: regular, fillets, nuggets, pop-corn.
3. Size: Fish and seafood products are sold in different packaging sizes from few ounces to 5 lb or more.

This product differentiation is always accompanied with difference in pricing (Table 8). According to a previous study, between 16 and 34% of products available in two or more package found in retail grocery outlets exhibit a quantity surcharge. The hypothesis here is that consumers do not expect the price for various types, forms, and package sizes of fish and seafood products to be the same. In other words, consumers view these products as imperfect substitutes, that is, shrimp packaged in a 32 oz package may not cost the double of a 16 oz package.

Table 7. Spatial variations in compensated cross-price elasticities of finfish products in the U.S. supermarkets.

Equation→	Salmon	Tilapia	Whiting	Cod	Flounder	Pollock	Catfish
Salmon	-2.17 - -0.83	0.08 - 0.84	0.21 - 1.78	-0.12 - 1.39	0.11 - 1.14	-0.63 - 3.02	-4.61 - 0.67
Tilapia	0.10 - 1.04	-2.31 - -1.09	0.01 - 2.08	-0.81 - 0.95	-0.18 - 2.18	-0.01 - 1.67	-0.57 - 1.14
Whiting	0.10 - 0.81	0.00 - 0.77	-3.37 - -1.36	-1.38 - 0.63	-1.87 - 3.69	-4.90 - 0.93	-1.10 - 1.32
Cod	-0.03 - 0.40	-0.19 - 0.22	-0.87 - 0.40	-2.45 - -0.07	-1.51 - 0.60	-0.69 - 4.49	-0.20 - 2.09
Flounder	0.02 - 0.24	-0.03 - 0.38	-0.87 - 1.72	-1.11 - 0.44	-2.30 - -1.12	-0.14 - 1.32	-0.26 - 2.08
Pollock	-0.08 - 0.38	0.00 - 0.17	-1.34 - 0.25	-0.30 - 1.95	-0.08 - 0.77	-2.77 - -0.21	-0.29 - 0.51
Catfish	-1.24 - 0.18	-0.12 - 0.25	-0.65 - 0.78	-0.19 - 1.97	-0.33 - 2.65	-0.64 - 1.11	-5.00 - -0.70
Halibut	-0.08 - 0.10	0.00 - 0.06	-0.02 - 0.28	-0.26 - 0.14	-0.04 - 0.18	-0.27 - 0.46	-0.20 - 0.28
Orange roughy	-0.07 - 0.06	-0.03 - 0.15	-0.10 - 0.18	-0.10 - 0.10	-0.16 - 0.11	-0.11 - 0.16	-0.14 - 0.75
Mahi mahi	-0.04 - 0.03	-0.07 - 0.10	-0.10 - 0.12	-0.11 - 0.20	-0.09 - 0.18	-0.58 - 0.11	-0.20 - 0.24
Tuna	0.00 - 0.06	-0.04 - 0.09	0.00 - 0.18	-0.15 - 0.19	-0.17 - 0.43	-1.19 - 0.53	-0.04 - 0.23
Swordfish	-0.03 - 0.06	-0.03 - 0.05	-0.09 - 0.11	-0.15 - 0.31	-0.16 - 0.06	-0.41 - 0.05	-0.23 - 0.28
Perch	-0.03 - 0.27	0.01 - 0.16	-0.24 - 0.43	-0.47 - 0.21	-0.93 - 0.28	-0.24 - 0.47	-0.31 - 0.93
Equation	Halibut	Orange roughy	Mahi mahi	Tuna	Swordfish	Perch	
Salmon	-0.67 - 0.80	-0.36 - 0.32	-0.39 - 0.33	0.01 - 0.68	-0.55 - 1.08	-0.21 - 1.75	
Tilapia	-0.03 - 0.58	-0.17 - 0.90	-0.91 - 1.35	-0.50 - 1.16	-0.69 - 1.18	0.10 - 1.24	
Whiting	-0.09 - 0.99	-0.23 - 0.41	-0.50 - 0.59	-0.02 - 0.89	-0.75 - 0.90	-0.70 - 1.27	
Cod	-0.60 - 0.31	-0.14 - 0.14	-0.34 - 0.63	-0.47 - 0.61	-0.81 - 1.65	-0.88 - 0.39	
Flounder	-0.06 - 0.31	-0.17 - 0.12	-0.22 - 0.42	-0.39 - 1.01	-0.62 - 0.24	-1.28 - 0.39	
Pollock	-0.26 - 0.45	-0.07 - 0.10	-0.77 - 0.15	-1.63 - 0.73	-0.95 - 0.13	-0.19 - 0.38	
Catfish	-0.42 - 0.60	-0.19 - 1.00	-0.58 - 0.69	-0.11 - 0.68	-1.17 - 1.42	-0.54 - 1.63	
Halibut	-1.23 - -0.73	-0.10 - 0.06	-0.13 - 0.17	-0.31 - 0.10	-0.34 - 0.23	-0.09 - 0.17	
Orange roughy	-0.16 - 0.09	-1.06 - -0.88	-0.04 - 0.18	-0.11 - 0.16	-0.14 - 0.27	-0.03 - 0.16	
Mahi mahi	-0.09 - 0.13	-0.02 - 0.08	-1.20 - -0.58	-0.10 - 0.26	-0.02 - 0.45	-0.22 - 0.34	
Tuna	-0.23 - 0.07	-0.05 - 0.07	-0.09 - 0.26	-2.89 - -0.88	-0.12 - 0.27	-0.15 - 0.26	
Swordfish	-0.15 - 0.10	-0.04 - 0.07	-0.01 - 0.26	-0.07 - 0.16	-1.14 - -0.56	-0.10 - 0.08	
Perch	-0.11 - 0.21	-0.02 - 0.12	-0.36 - 0.57	-0.25 - 0.44	-0.29 - 0.22	-2.55 - -0.63	

Note: Values in bold are uncompensated own-price elasticities.

Table 8. Average prices for catfish products.

Product	Average Price (\$/pound)
Catfish (entire category)	3.0890
Catfish entrée breaded	4.4209
Catfish unbreaded	2.4975
Catfish unbreaded	3.1578
Catfish fillet medium size (between 1 and 3 pound)	4.6570

However, when many products are involved, the number of parameters to be estimated in order to analyze demand increases. Traditional demand estimation, such as the linear expenditure system (LES), the almost ideal demand system (AIDS), and the Rotterdam model are inappropriate to cope with the

dimensionality problem. Researchers in applied demand analysis have devised techniques to overcome the dimensionality problem. One of these techniques relies on the assumption of weak separability and multi-stage budgeting, allowing the researchers to concentrate on a single group, and sidestepping the effect of important factors such as the type, the form, and the size.

The development of discrete choice methods offers a very practical alternative to solve the dimensionality problem and estimate demand parameters at more disaggregate levels. In our context, the use of discrete choice approach allows estimating taste parameters for product characteristics such as the form, the type, and the package size of the product. For example, unbreaded tilapia fillet, sold in 48 oz pack is treated as a different product than unbreaded tilapia, fillet, sold in 16 oz pack. In doing so, we are able to identify consumers' preferences for the product (tilapia vs. catfish, for example), the coating (breaded vs. unbreaded), the form (fillet vs. nugget), and the package size.

In this study, the weekly purchase of fish and seafood products from June 2008 to June 2010 in United States was studied. Six categories of frozen fish and seafood products are considered: catfish, clams, shrimp, salmon, tilapia, and tuna. Results from this study are:

- Overall, the more the product is narrowly defined, the bigger is the magnitude of the own-price elasticity. For instance, a 10% increase in the price of catfish, will reduce the sales of catfish by 4.8%; while a 10% increase in the price of family size breaded catfish nugget will decrease the sales by 44.2%.
- At the type level (catfish, shrimp,...), the results show no pattern. We cannot say, for instance, that the demand for catfish is more price sensitive than demand for shrimp or vice versa.
- In regard to the form, demand for entrée products is more price sensitive than the other forms, regardless of the category of fish or seafood.
- U.S. consumers are more price sensitive for catfish fillet than for catfish nuggets.
- For the package size, out of 33 products analyzed, 31 have their price sensitivity decreasing as the package size increases, implying quantity discount.
- For the cross-price elasticities, they are all positive and of small magnitude, which is consistent with highly differentiated products theory.

Sub-Objective 3.c. *Construct policy analysis matrices (PAM) and estimate domestic resource costs (DRC) for various aquaculture products of the southern region of the US.*

Auburn University

The U.S. farm-raised catfish industry has contributed significantly to the economic development of rural economies in the southern U.S. The industry enjoyed a long period of continuous growth for several decades until the early 2000s. Since 2003 the industry has been experiencing reductions in production acres, output, and sales volume and values. The declines are attributed primarily to the competition with substitute catfish-like imports and increases in production input costs, especially for feed and fuel. Knowledge of the comparative advantage and disadvantages of the U.S. catfish industry will help improve policy interventions and provide catfish producers with science-based decisions on ways to improve their profitability.

This research objective constructed an industry budget using both market and shadow prices. The resulting industry budgets are employed to build the policy analysis matrix (PAM), and derive domestic resource cost (DRC) and other economic indicators, such as nominal protection coefficients of inputs and outputs, to evaluate the comparativeness, and efficiencies of resources used in the U.S. farm-raised catfish industry. Data used in this analysis include costs and revenues of catfish farm production in four regions, a black belt soil region in west Alabama and one in east Mississippi, and in the lower and upper delta regions of western Mississippi. Data covered a 5-year production span from 2005 to 2009. Results

presented in Table 9 show that catfish producers received market prices that were close to its social/shadow prices. Over the study period, U.S. catfish producers faced an implicit tax on their output sale in 2005 as shown by the nominal protection coefficient of output being less than one. However, the situation improved in the following years. In terms of input use, U.S. catfish producers received small indirect supports from U.S. farm policy through subsidies provided to certain crops such as corn, soybean, and wheat that are ingredients in catfish feed. The industry used to have a comparative advantage in 2005 and 2006 when the domestic resource cost (DRC) ratio was less than one, but due to increases in feed price in later years, U.S. catfish production has demonstrated a comparative disadvantage to foreign competitors.

Ratios	2005	2006	2007	2008	2009
Domestic resource cost (DRC)	0.84	0.71	1.31	14.57	1.76
Nominal protection coefficient on tradable output (NPCO)	0.96	1.00	1.05	1.01	1.02
Nominal protection coefficient on tradable input (NPCI)	0.95	0.91	0.92	0.93	0.93
Effective protection coefficient (EPC)	0.96	1.17	1.56	6.42	1.32

The U.S. farm-raised catfish industry has become comparatively disadvantaged recently due to low prices paid to producers, both in terms of private and social prices, for the years 2005 through 2009 (in 2011 pond bank prices rose by 66%). The private price paid to catfish producers were determined by interactions in the domestic market and little public price intervention. However, the social price paid to producers could be improved by reducing competition with inexpensive imported aquaculture products through import tariffs. Simulations of different tariff levels on catfish-like imported products were conducted and suggested that a 25% increase in tariff level would have helped the U.S. farm-raised catfish industry in its worst year, 2008, have a comparative advantage.

Sub-Objective 3.d. *Preparing fact sheets based on previous results and provide information on how to improve competitive position of aquaculture producers and processors in the southern region of the U.S.*

University of Arkansas at Pine Bluff

This sub-objective is being addressed through a combination of formal presentations to professional meetings and trade associations and individual meetings and consultations with farmers and processors. Formal presentations have been made at the World Aquaculture Society Aquaculture 2013, North American Association of Fisheries Economists Forum 2013, and Aquaculture Business Management and Marketing Workshops organized by the National Aquaculture Association. These presentations focused on explaining to industry members how the markets for U.S. aquaculture products can be expanded.

Auburn University

This sub-objective is being addressed now based upon results presented in presentations to the Aquaculture America 2013 and Food Distribution Research Society meetings.

IMPACTS

- The project has acquired store level scanner data for 12,898 seafood products. The data includes information on 84 seafood species (or species groups) of unbreaded frozen products, 30 species of breaded frozen products, 40 species of entrées, and 5 species of canned products. The data covers 209 marketing chains over 52 U.S. cities and all U.S. Census divisions. The data period is from four weeks (cumulative) ending on 07/16/2005 to four weeks (cumulative) ending on 06/16/2007 and from week ending on 06/23/2007 to week ending on 06/12/2010 (total 156 weeks).
- The cost of an individual report developed from scanner data begins at \$200,000. Summaries of market trends in 52 cities across the U.S. for the past 5 years have been sent to 19 catfish processing companies, and detailed customized reports have been sent to 6 catfish processing companies at their request. Given the 25 reports that have been prepared for individual companies, the total value of these reports provided to industry (at no cost to them) over the past year is \$5 million.
- Supermarket and household level scanner data have potential to provide guidance to seafood marketers on trends of specific products, product forms, and product substitutes in specific markets.
- The results have been communicated among various farmer and processor groups throughout the country. Several aquaculture farmers/processors have used the project results in designing or redesigning their marketing plans.
- Though the demand for fresh and chilled/frozen seafood has been increasing over time in the US, the market size and share of US farm-raised catfish are declining. Increased understanding of demand structure of sales of seafood and fish over season and space could help the U.S. aquaculture industry refine marketing strategies and targets.
- The study found that the catfish industry needs to develop market specific strategies in order to gain further market share in the U.S. Results show that the responsiveness of catfish demand to changes in its own and substitute products prices vary over seasons and U.S. census divisions. Researchers have conveyed to stakeholders (Catfish farmers, processors, policy makers) that understanding the consumer demand behavior across seasons and over space is essential as (i) fish demand varies over species, season and space; and (ii) not only does the degree of competition among finfish products vary considerably over space, but substituting products themselves change.
- Based on these findings, several catfish farmers and processors have expressed intention to develop market specific strategies for catfish marketing. The industry has invited the Aquaculture/Fisheries Center to further assist them with designing their marketing plans. The Catfish Institute, an industry managed organization responsible to raise consumer awareness of the positive qualities of US Farm-Raised Catfish, has requested the Aquaculture/Fisheries Center to help them in organizing region-specific advertisement messages for the industry.
- Several catfish farmers, processors and the Catfish Institute have used the project results to develop market specific strategies in order to gain further market share in the U.S.

PUBLICATION, RESEARCH PAPERS SUBMITTED, AND PRESENTATIONS

Publications in Print

Chidmi, B., T. Hanson, and G. Nguyen. 2012. Substitutions between U.S. and imported fish and seafood products at the national retail level. *Marine Resource Economics* 27(4): 359-370.

Gold, G. C. 2012. The implicit prices of finfish and shellfish attributes and retail price promotion strategies: hedonic analysis of weekly scanner data in the U.S. M.S. Thesis, Food and Resource Economics Department, University of Florida, Gainesville, FL.

K. Singh, M. M. Dey and P. Surathkal. 2013. "Seasonal and Spatial Variations in Demand for and Elasticities of Fish Products in the United States: An Analysis based on Market-level Scanner." Accepted for publication in *Canadian Journal of Agricultural Economics*.

M. M. Dey, A. G. Rabbani, K. Singh and C. R. Engle. 2013. "Determinants of Retail Price and Sales Volume of Catfish Products in the United States: An Application of Retail Scanner Data." Accepted for Publication in *Aquaculture Economic and Management*.

Manuscripts in Preparation

Chidmi, B., T. Hanson, and G. Nguyen. Effect of promotional activities on substitution pattern and market share for aquaculture products. *Journal of the Food Distribution Research Society* (in review).

Chidmi, B., T. Hanson, and G. Nguyen. Substitutions between U.S. and imported fish and seafood products at the national retail level. *Marine Resource Economics* (in review).

Hanson, T. R., G. Nguyen, and C. Jolly. 2012. Comparative advantage of the U.S. farm-raised catfish industry: a cross-regional domestic resource cost analysis. *Journal of Aquacultural Economics and Management* (in press).

Singh, K. and M. M. Dey. Retail level demand for canned seafood in the U.S: estimates from almost ideal demand system using scanner data. *Journal of Agricultural and Applied Economics* (in review).

Singh, K.; M. M. Dey, and P. Surathkal. Analysis of demand system for unbreaded frozen seafood in the U.S. using store-level scanner data. *Marine Resource Economics*, 27(4) (in press).

Singh, K.; M. M. Dey, and P. Surathkal. Price and scale flexibilities of white fish products in the United States: a seasonal and regional analysis based on store-level scanner data. *Canadian Journal of Agricultural Economics* (in review).

Surathkal, P. and M. M. Dey. Consumer demand for frozen and chilled seafood products in the United States: an analysis using market-level retail scanner panel data (in review).

Abstracts

- Dey, M., K. Singh, C. R. Engle, A. Rabbani, and P. Surathkal. 2011. Trends in seafood markets in the United States: reflections from store level scanner data. p. 58 in NAAFE Forum 2011 Program, University of Hawaii at Manoa and NOAA Fisheries, Silver Spring, MD.
- Hanson, T. R. and G. V. Nguyen. 2012. Crawfish market overview for the southeastern U.S. Book of Abstracts of Aquaculture America 2012 meeting, Las Vegas, NV.
- Larkin, S., M. Dey, C. Roheim, B. Chidmi, P. Surathkal, and F. Asche. 2011. Hedonic analysis of seafood scanner data: an application to southern U.S. Markets. p. 63 in NAAFE Forum 2011 Program, University of Hawaii at Manoa and NOAA Fisheries, Silver Spring, MD.
- Nguyen, G.V. and T. R. Hanson. 2012. Comparative advantage of the Alabama farm-raised catfish industry. Book of Abstracts of Aquaculture America 2012 meeting, Las Vegas, NV.
- Rabbani, A. G., M. M. Dey, K. Singh, and P. Surathkal. 2011. Market trends of frozen catfish products at the supermarkets of the USA: an application of national scanner data. p. 51 in NAAFE Forum 2011 Program, University of Hawaii at Manoa and NOAA Fisheries, Silver Spring, MD.
- Singh, K. and M. Dey. 2011. Demand for seafood in the United States: econometric analysis for major seafood categories and seafood canned products. p. 208 in 16th Biennial Research Symposium 2011, Association of Research Directors, Atlanta, GA.
- Singh, K., M. M. Dey, and P. Surathkal. 2011. Inverse almost ideal demand system for unbreaded frozen seafood in the United States: estimation of demand flexibilities using full system of equations with theoretical Restrictions. p. 57 in NAAFE Forum 2011 Program, University of Hawaii at Manoa and NOAA Fisheries, Silver Spring, MD.
- Surathkal, P., M. Dey, C. Engle, and K. Singh. 2011. Demand for catfish, crawfish, clam, and shrimp in the United States: effects of demographic and product characteristics. p. 59 in NAAFE Forum 2011 Program, University of Hawaii at Manoa and NOAA Fisheries, Silver Spring, MD.
- Surathkal, P.; A. Rabbani, M. Dey, and K. Singh. 2011. Recent trends in marketing of aquaculture products in the United States: results from store-level scanner data. p. 202 in 16th Biennial Research Symposium 2011, Association of Research Directors, Atlanta, GA.

Presentations

- Adams, C. January 2011. Florida Clam Industry Workshop, Cedar Key, FL.
- Chidmi, B. 2011. Modeling consumer demand for type, form, and package size in the seafood and fish industry. INFORMS Marketing Science Conference, Houston, TX.
- Chidmi, B., T. Hanson, and G. Nguyen. 2011. Effect of promotional activities on substitution pattern and market share for aquaculture products. 52nd Annual Conference of the Food Distribution Research Society-FDRS, Portland, OR.
- Chidmi, B., T. Hanson, and G. Nguyen. 2011. Substitutions between U.S. and imported aquaculture products at retail market level. NAAFE Forum 2011, Honolulu, HI.

- Dey, M. M. 2012. Retail markets for trout in the USA: an analysis of store level scanner data. Presented at the U.S. Trout Farmers Association 2012 Fall Conference in Denver, CO.
- Dey, M. M. 2012. Supermarkets sales trends for aquaculture products. Aquaculture Business Management and Marketing Workshop organized by the National Aquaculture Association at the University of South Florida, St Petersburg, FL.
- Dey, M. M. 2012. Supermarkets sales trends for aquaculture products. Aquaculture Business Management and Marketing Workshop organized by the National Aquaculture Association at the College of Southern Idaho Campus, Twin Falls, ID, Dundee, MI, and the United States Trout Farmers Association in Denver, CO.
- Dey, M. M. 2013. Market Trends for Fish/Seafood Products: Global and US City-level Analysis. Presented at Aquaculture Business Management and Marketing Workshop on May 22, 2013 in Charleston, SC, U.S.A.
- Dey, M. M. 2013. Market Trends for Fish/Seafood Products: Global and US City-level Analysis. Presented at Aquaculture Business Management and Marketing Workshop on July 29, 2013 at the University of Hawaii at Manoa Campus, Hawaii, U.S.A.
- Dey, M. M. 2013. Market Trends for Fish/Seafood Products: Global and US City-level Analysis. Presented at Aquaculture Business Management and Marketing Workshop on July 30, 2013 in Hilo, Hawaii, U.S.A.
- Dey, M. M. 2013. Market Trends for Fish/Seafood Products: Global and US City-level Analysis. Presented at Aquaculture Business Management and Marketing Workshop on August 14, 2013 in New Bern, NC, U.S.A.
- Dey, M. M. 2013. Market Trends for Fish/Seafood Products: Global and US City-level Analysis. Presented at Aquaculture Business Management and Marketing Workshop on September 24, 2013 at the University of Southern Illinois, Carbondale, IL.
- Dey, M. M. 2013. Market Trends for Fish/Seafood Products: Global and US City-level Analysis. Presented at Aquaculture Business Management and Marketing Workshop on October 17, 2013 in Galloway, NJ, U.S.A.
- Dey, M. M., K. Singh, and P. Surathkal. 2013. Seasonal and Spatial Variation in Demand for and Elasticity of Fish Products in the United States: An Analysis of Market-Level Scanner Data. Paper presented at the World Aquaculture Society Conference, Aquaculture 2013, Nashville, Tennessee, February 21-25, 2013.
- Dey, M., K. Singh, C.R. Engle, A. Rabbani, and P. Surathkal. 2011. Trends in seafood markets in the United States: reflections from store level scanner data. NAAFE Forum 2011, Honolulu, HI.
- Dey, M. M. and K. Singh. 2012. Regional and seasonal variation for catfish and its substitutes in the United States: implications for developing marketing strategies. 2012 Catfish Research Symposium, Catfish Farmers of American Annual Convention, Savannah, GA.
- Engle, C. R. 2011. National supply and demand for trout, supermarket sales data, and economic tools for survival. U.S. Trout Farmers Annual Convention, Twin Falls, ID.

- Engle, C. R. 2011. Supermarket sales of catfish and competing products: what does recent scanner data tell us? Annual Convention of the Catfish Farmers of America, Mobile, AL.
- Engle, C. R. and M. Dey. 2011. Supply models for trout: industry wide effects of changing costs, prices and international exchange rates. Aquaculture America 2011, New Orleans, LA.
- Gold, G. and S. Larkin. 2012. The implicit prices of finfish and shellfish attributes and retail promotion strategies: hedonic analysis of weekly scanner data in the U.S. southeast. AgEcon Search, Southern Agricultural Economics Association 2012 Annual Meeting, Birmingham, AL. Available at <http://purl.umn.edu/119806>.
- Gold, G., S. Larkin, and C. Adams. 2012. The value of a word: estimating the implicit prices of popular finfish and shellfish labeling practices in the U.S. International Institute of Fisheries Economics and Trade Biennial Conference, Tanzania, Africa.
- Hanson, T. and G. Nguyen. 2011. Comparative advantage of the U.S. catfish aquaculture sector. NAAFE Forum 2011, Honolulu, HI.
- Hanson, T. and G. Nguyen. 2012. Supermarket sales of crawfish and competing crustacean products. 53rd Annual Conference of the Food Distribution Research Society-FDRS, San Juan, PR.
- Hanson, T.R. and G. V. Nguyen. 2012. Crawfish market overview for the Southeastern US. Aquaculture America 2012 meeting, Las Vegas, NV.
- Larkin, S., M. M. Dey, C. Roheim, B. Chidmi, P. Surathkal, and F. Asche. 2011. Hedonic analysis of seafood scanner data: an application to southern U.S. markets. NAAFE Forum 2011, Honolulu, HI.
- Larkin, S.L. and C.M. Adams. 2012. Using retail-level scanner data for a revealed preference analysis fish and seafood products sold in the U.S. W2004 (Marketing, Trade, and Management of Aquaculture and Fishery Resources) 2012 Workshop, Cedar Key, FL.
- Nguyen, G.V. and T.R. Hanson. 2012. Comparative advantage of the Alabama farm-raised catfish industry. Aquaculture America 2012 meeting, Las Vegas, NV.
- Rabbani, A.G., M. Dey, K. Singh, and P. Surathkal. 2011. Market trends of frozen catfish products at the supermarkets of the USA: an application of national scanner data. NAAFE Forum 2011, Honolulu, HI.
- Singh, K. and M.M. Dey. 2011. Demand for seafood in the United States: econometric analysis for major seafood categories and seafood canned products. 16th Biennial Research Symposium 2011, Association of Research Directors, Atlanta, GA.
- Singh, K., M. M. Dey, and P. Surathkal. 2011. Inverse almost ideal demand system for unbreaded frozen seafood in the United States: estimation of demand flexibilities using full system of equations with theoretical restrictions. NAAFE Forum 2011, Honolulu, HI.
- Surathkal, P., A. Rabbani, M. Dey, and K. Singh. 2011. Recent trends in marketing of aquaculture products in the United States: results from store-level scanner data. 16th Biennial Research Symposium 2011, Association of Research Directors, Atlanta, GA.

Surathkal, P., M. Dey, and K. Singh. 2013. Consumer Demand for Frozen Seafood Products in the United States: An Analysis Using Market-level Retail Scanner Panel Data. Paper presented at the North American Association of Fisheries Economists Forum 2013, May 21-24, 2013, St. Petersburg, FL, USA.

Surathkal, P., M. Dey, C. Engle, and K. Singh. 2011. Demand for catfish, crawfish, clam, and shrimp in the United States: effects of demographic and product characteristics. NAAFE Forum 2011, Honolulu, HI.



United States
Department of
Agriculture

National Institute
of Food and
Agriculture

The work reported in this publication was supported in part by the Southern Regional Aquaculture Center through Grants from the United States Department of Agriculture, National Institute of Food and Agriculture.