Consumer Demand for Ahi Poke (Raw Tuna Salad) in Hawaii

Pedro M. Fernandes da Costa* (contact author)
Graduate Research Assistant
University of Kentucky
Department of Agricultural Economics
406 Charles E. Barnhart Building
Lexington, KY 40546-0276
Phone: 859.257.7272 ext. 259
Fax: (859) 323-1913
E-mail: pedro.dacosta2@uky.edu

Wuyang Hu
Assistant Professor
University of Kentucky
Department of Agricultural Economics
406 Charles E. Barnhart Building
Lexington, KY 40546-0276
Phone: 859.489.7166
Fax: 859.489.7290
E-mail: wuyang.hu@uky.edu

Miling Pan
Economist and Program Manager
Pacific Islands Fisheries Science Center
NOAA National Marine Fisheries Service
2570 Dole Street
Honolulu, HI 96822
Phone: 808.944.2190
Fax: 808.983.2902
Email: minling.pan@noaa.gov

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 6-9, 2010

Abstract

Ahi poke (raw tuna salad) has significant role in Hawaii culture and economy. A consumer survey in Hawaii was used to examine consumers' purchasing intentions of *ahi poke*. A censored analysis was conducted to analyze the demand and tie with various consumer characteristics. Results show that many consumer eat *ahi poke* frequently and different consumer profiles will lead to large differences in their demand. Information obtained in study may help producers and retailers to better target their marketing strategies and increase sales.

Key words: Ahi Poke, Demand, Hawaii, Tobit

JEL code: Q13, D12

1. Introduction

According to the National Oceanic and Atmospheric Association (NOAA), world commercial fishery landings and aquaculture production in 2006 were 143.6 million metric tons, an increase of 0.9 million metric tons compared with 2005 (NOOA, 2008). Although seafood consumption has been steadily increasing in the U.S. from 2006 to 2007 edible fish and shellfish landings had a slight decrease of 376,300 thousand pounds with a total of 7.5 billion of pounds. Also in 2007, supply of edible fishery products in the U.S., which accounted for domestic landings and imports minus exports, had an increase of 123.6 million pounds compared with 2006 with a total of 12.5 billion pounds. The industrial supply of fishery products in 2007 had an increase of 53.2 million pounds compared with 2006, totalizing 959.7 million pounds. Although this study examines consumer demand for *ahi poke* (raw tuna salad) only in Hawaii, the information obtained may have implications on world tuna market. According to Food and Agriculture Organization of The United Nations (FAO) State of World Fisheries and Aquaculture, tuna is between the ten species that most contributed to global catches in 2006 (FAO, 2008).

To understand the demand for *ahi poke*, it is useful to understand the perspectives of overall seafood production and consumption. In 2007 Americans consumed 4.9 billion pounds fish and shellfish, and the U.S. continues to be ranked the third largest consumer for fish and shellfish after China and Japan. This means on average Americans ate 16.3 pounds of edible meat of fish and shellfish per person in 2007 (NOAA, 2008). Fresh and frozen shellfish consumption was 5.5 pounds per capita, while fresh and frozen finfish accounted for 6.6 pounds. However, this per capita consumption remains below many other countries due to possibly geographic, socio-

economic, and/or cultural reasons. Besides, eighty percent of U.S. seafood that is consumed is from imported sources, meaning that American demand for seafood has an impact on fisheries worldwide.

According to NOAA's Fisheries Service (NOAA, 2008), consumers in U.S. spent an estimated $68.4 billion for fishery products in 2007. From the total of this amount $45.8 billion were expenditures in food service establishments (restaurants, carry-outs, caterers, etc.); $22.1 billion were expenditures in retail sales for home consumption; and $474.2 million were expenditures for industrial fish products. The U.S. commercial marine fishing industry, by producing and marketing a variety of fishery products, including foreign and domestic markets, contributed to the Gross National Product with $34.2 billion in value added.

This expansion or the trend in seafood consumption in US may be explained by the benefits of consuming seafood meat compared to other types of protein. Studies show that consumption of fish, especially fatty cold-water species such as salmon, mackerel, sardines, and herring, protects against cardiovascular disease and promotes human brain development (Mozaffarian and Rimm, 2006; Institute of Medicine, 2007). Other studies suggest that eating fish can lower the risk of developing some types of cancer, asthma, diabetes, rheumatoid arthritis and other inflammatory diseases, Alzheimer's disease, depression, and macular degeneration (Rose Connolly, 1999; Calder, 2006; Hodge et al., 2006). The American Heart Association recommends that adults consume fish at least twice per week to protect against cardiovascular disease. The Dietary Guidelines for Americans published by the U.S. Department of Health and Human Services

(2005) recommends consuming fish, as well as nuts and vegetable oils, to maximize mono and polyunsaturated fats in our diets.

Following similar trend, a more regional U.S. seafood consumption comparison can be made with Hawaii state's largest and most valuable fishery sector, the pelagic fisheries (fish live in the near-surface waters of the ocean), which include the longline, main Hawaiian Islands troll and handline, offshore handline, and the aku boat (pole and line) fisheries. Tuna species were one of the largest components of pelagic catch in 2003, being the Bigeye tuna (*Thunnus obesus*) the largest between the tunas (Pelagics Annual Report, 2007). In 2007, imported Tunas from Hawaii accounted for a total of 1.19 million pounds, while exported accounted for 0.14 million pounds (NOAA, 2009), and locally caught were 18.84 million pounds.

Seafood consumption is an intrinsic feature of Hawaii's culture, from traditional Polynesian uses of nearshore and reef species to the importance of seafood in Asian cultures (Costa, 1998). As a consequence of cultural adaptation by the population and active promotion of local seafood in restaurants oriented toward tourism, per capita seafood consumption in Hawaii is high, and a very large percentage of which is fresh fish (Higuchi and Pooley, 1985; East-West Research Inst., 1989).

Moreover, Hawaiian economy is dominated by tourism and Hawaii is a densely populated state in the U.S. where Honolulu sprawls in the Island of Oahu, and has a density greater than New Jersey, one of the most densely populated states in U.S. Besides, fishing and seafood marketing have been important bridges into Hawaiian commercial society for several immigrant groups,

from the Japanese, Chinese, and Portuguese who came to Hawaii as plantation workers at the turn of the century to Koreans and North Americans who came for more varied reasons over the past 30 years.

Given the importance of Hawaiian seafood industry, it is surprising that there has been very little research done in this area. This article examines consumer demand for *ahi poke* in Hawaii. Despite being a popular dish in Hawaii, little is known on what types of individuals are consumers and how much they normally consume. Hawaii residents have traditionally consumed substantial amounts of fresh tuna primarily bigeye (*Thunnus obesus*) and yellowfin (*T. albacares*) as *ahi poke*, bite-sized pieces of raw tuna mixed with seasoning like seaweed and *kukui* nut relish, and *ahi sashimi*, sliced raw tuna (Titcomb, 1977). This market niche is of importance on the supply of tuna for retailers, the market price for consumers, associated with the market share of fresh and local tunas and its impact on the Hawaii-based longline fisheries, as well on the increasing consumption of imported frozen tuna and its significant economic ramifications in the local fishery industry.

This study will investigate the factors attributing to the demand for *ahi poke* from the consumers' perspective from a survey implemented in Hawaii local consumer markets in 2008, deriving differences in consumption patterns by demographic characteristics and other consumer preferences for *ahi poke* purchases. To address this objective, the rest of the paper is divided into five sections: first we outline the data collection method; then descriptive nature of data collected is discussed; following this, the econometric model used to analyze consumption is

introduced; the estimation results are subsequently discussed; and the conclusion section summaries and extends findings of this study.

2. Survey Design and Implementation

To study consumer demand, one of the most straightforward ways to obtain related data is through observed purchasing history. Such data may commonly come from grocery store scanners. However, despite the popularity of *ahi poke* in the Hawaiian diet, there has been no reported previous effort of collecting such data. While some aggregated statistics on overall consumption may be available, no data on individual-level consumption are readily accessible. Even scanner data can be successfully gathered by contacting related grocery stores or a central governing organization, these data are often severely limited. They usually do not contain information on consumer or household characteristics, their perceptions on food, or other consumption experience.

To solve this problem, some researchers and marketing firms relied on scanners that can be used at home by consumers after each grocery trip. These home-scanned data can then be matched with consumer characteristics. However, this approach also faces significant challenges in studying *ahi poke* consumption. After preliminary investigation, it is found that a significant number of consumers buy *ahi poke* from local grocery stores or Farmers' Markets. Many of these outlets sell store-made *ahi poke* that do not bear any barcode. Consumers would have to enter the amount they purchased into the database without the scanner. To address these issues, a conventional intercept survey approach is adopted to collect data.

The survey was designed with the assistance of two focus groups and pre-tested using randomly intercepted consumers at several grocery stores. The final survey was implemented during January 2008 and May 2008. In order to capture an accurate sample distribution of demographics in the states and to reach the largest scope of potential consumers, several distinctive locations in Hawaii were chosen as the survey locations. Local Farmer's Markets were identified since a significant number of individuals visit these markets for indigenous foods. Longs Drugs Stores were also chosen because this is one of the most visited general/convenience store chains in Hawaii. Sites around the University of Hawaii at Manoa campus were also chosen as survey locations. This is because there are a large variety of shops and restaurants in this area attracting a highly diverse group of customers.

Permissions to survey on business properties were obtained. The Hawaii Farm Bureau Federation and Longs Corporate Offices also approved permission for surveying at Farmer's Market locations, like Kapiolani Community College, Mililani High School, and Hilo Farmer's Market, and Longs Drug Store locations, specifically in Kaneohe and Waipahu. A total of 430 surveys were completed, being 221 at Farmer's Markets and 209 at Longs Drugs Stores and around the University of Hawaii at Manoa.

For the key consumption variable, the survey asked respondents to recall the amount of *ahi poke* they consumed over the past month. The rest of survey questionnaire was designed to collected information on three aspects. The first collects information on respondents' general demographic and socioeconomic characteristics, such as gender, ethnicity, education, age,

household income, and household size. The second aspect includes questions that ask each respondent to recall their consumption history of *ahi poke* including whether the respondents eat *ahi poke*, and whether they ever purchased pre-made *ahi poke*. The third aspect includes questions to differentiate preferences for fresh and frozen poke such as and if they prepare their own poke from *ahi* blocks, steaks or loins.

3. Data

Sample descriptive statistics of some key demographic variables are reported in Table 1. When compared to the census data from 2000 published by the Department of Business, Economic Development and Tourism (DBEDT), the overall features of the sample collected in this study resemble well with the population distribution. The sample appears to have higher education level than the population average. In addition, as expected, this survey would capture more responses from Japanese and Native Hawaiians, as raw fish is both a native Japanese and Hawaiian delicacy.

[Table 1 here.]

Other information collected in the survey related to household characteristics and specifically to *ahi poke* consumption is not directly comparable to the census data but it also offers significant insights. Based on the 427 surveyed consumers, 92.97% are Hawaiian resident, 82.44% live in the Island of Oahu. A total of 44.5% of the respondents eat *ahi poke* at least once a month, and 43.79% eat *ahi poke* at least once a week, thus confirming the popularity of *ahi poke* and the potential importance of this product to the locals' diet. In terms of the general household

characteristics, 33.04% of the respondents have at least three generations of their family lived in Hawaii while the average in the total population of Hawaii residents is 4.2 generations. In the sample, the average household size is 2.8 members per household and the mean age of the sample approximately 48 years old. The average education level of the sample is 15 years and the average household income was approximately $70,521 per year. This level of income may appear to be high compared to other states in the U.S. Nevertheless, the cost of living in Hawaii is also significantly higher than the national average (CNN Money 2009). Also, 54.1% of the consumers like to prepare their own *ahi poke* from *ahi* blocks, steaks or loins, while 58.31% of the respondents affirmed that have eaten or purchased previously frozen (thawed prior to sale) *ahi poke*. For the consumers in the study region, the sample suggests that an average household would consume about 2 pounds of *ahi poke* per month.

Knowing general household characteristics and consumer patterns is crucial for understanding the basic structure of the local economy and the factors that may serve as stimulus for growth and change. By tying consumer's characteristics and their consumption behavior together, a series of analysis for this purpose are given through the empirical models discussed in the following section, with the intention of providing a more comprehensive view of the demand for *ahi poke* in Hawaii.

4. Model

In this study, the dependent variable is the consumption of *ahi poke* and it is a mixture of observations that contain zeros and positive values. Since it is not possible for consumers to

report negative consumption values, the dependent variable is incompletely observed, and Ordinary least-squares (OLS) regression will not yield consistent parameter estimates. Thus, a censored normal regression model, the Tobit model, was used. Use of this procedure alleviates problems generated by ordinary least squares estimation, namely inconsistent estimates resulting from selectivity bias. The dependent variable *ahi poke* consumption measured by pounds per month is censored from below, or in other words, naturally non-negative. Suppose an equation can be specified to explain *ahi poke* consumption:

$$Y_i^* = X_i\beta + \varepsilon_i \qquad (1)$$

Y_i^* represents the latent amount of *ahi poke* consumption by individual *i* in the sample. This latent amount is allowed to have negative values which suggests that the more negative the consumption is, the less likely an individual will consume *ahi poke*. X_i is a matrix containing vectors of explanatory variables; β is a vector of unknown coefficient to be estimated; and ε_i is assumed to be an iid noise term following normal distribution: $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$ with unknown variance σ_ε^2 to be estimated.

The actual observed consumption as reported by respondents of the survey Y_i is only observed as positive when the latent expenditure is greater than zero:

$$\begin{cases} Y_i = 0 & when\ Y_i^* \le 0 \\ Y_i = Y_i^* = X_i\beta + \varepsilon_i & when\ Y_i^* > 0 \end{cases} \qquad (2)$$

The dependent variable can also be expressed as:

$$Y_i = \max(Y_i^*, 0) \qquad (3)$$

If Y_i were observed, meaning that if no observations are censored, (β, σ^2) would be estimated by Ordinary Least Square (OLS) in the usual way. Moreover, the tobit model is a combination of two implicit processes, which are explained by the same group of variables *X*:

1. a probit model for the consumption (discrete) decision:

$$\Pr ob\,(Y_i > 0) = \Phi(X_i\beta) \tag{4}$$

2. a truncated regression model for the continuous decision of how much consumption should be made (uncensored observations):

$$E(Y_i / Y_i > 0) = X_i\beta + \sigma\lambda_i(\frac{X_i\beta}{\sigma}) \tag{5}$$

Therefore, following Greene (2000), the tobit model arises when consumption decision (4), and the decision of what proportion of the product to purchase (5), have the same variables X_i and the same parameter vector β, then the combination between equations (4) and (5), for an observation in the sample, which could either be censored or not:

$$\Pr ob\,(Y_i > 0) * E(Y_i / Y_i > 0) = \Phi(\frac{X_i\beta}{\sigma})(X_i\beta + \sigma\lambda_i) \tag{6}$$

where

$$\lambda_i = \frac{\phi\left[\frac{0 - X_i\beta}{\sigma}\right]}{1 - \phi\left[\frac{0 - X_i\beta}{\sigma}\right]} = \frac{\phi\left(\frac{X_i\beta}{\sigma}\right)}{\Phi\left(\frac{X_i\beta}{\sigma}\right)} \tag{7}$$

λ_i is often referred to as Inverse Mills Ratio (IMR), and ϕ and Φ are standard normal density and distribution functions respectively.

However, coefficient of individuals' demographic and socioeconomic variables in the decision either to consume and/or how much to consume do not directly show the magnitude of the impacts. The effects on the conditional mean of the dependent variable of changes in the regressors in this censored regression, the marginal effects, are of potential interest. The marginal effects of a continuous variable X that is included in X_i can be calculated by differentiating the consumption with respect to this variable. For binary or categorical variables, marginal effects are calculated as the change of dependent variable given the binary or categorical change of the variables. If β is the coefficient associated with variable X in the consumption equation, then the marginal effects of continuous variables are:

$$\frac{dE(Y_i)}{dX_i} = \beta\Phi\left(\frac{X_i\beta}{\sigma}\right) \tag{8}$$

In this expression, the expression $\Phi\left(\frac{X_i\beta}{\sigma}\right)$ can be viewed as a scale factor. In the observed sample, this scale factor moves closer to one when the number of censored observations moves towards zero. When there are no censored observations, this scale factor will no longer be important and the coefficient β gives the marginal effect at the particular values of X_i. Table 2 reports descriptive statistics of variables to be used as explanatory variables in the analysis.

[Table 2 here.]

5. Results and Discussion

The primary interests in the model are the expected value of the outcome variable under censoring, and the marginal effect of a regressor on this expectation. Estimation result of the

Tobit model is presented in Table 3. The estimated σ parameter is highly significant suggesting a highly significant IMR in the process. This indicates that the Tobit model is preferred to the OLS regression. The Tobit model shows significant impacts on consumption behavior from the consumers' demographics and socioeconomic variables. Education levels (in years) and consumers' ethnicity background both have significant impact on consumption. Consumer's income (and the quadratic form) is not significant in explaining consumption while other variables describing *ahi poke* purchasing and consumption history are significant. The frequency of whether respondents eat *ahi poke*, whether consumers prepare *ahi poke* at home from *ahi* blocks/steaks/loins, and whether consumers have purchased or eaten previously frozen *ahi poke*, all may explain patterns of consumption of the product in Hawaii.

[Table 3 here.]

Some additional variables were also initially included in the participation equation. However, they are eventually dropped due to the low explanatory power observed. Models with different number of variables were all tested against each other for missing or additional variable bias. The current model presented in Table 3 is not rejected by all tests and is the most robust specification. These dropped variables include characteristics such as location and type of market. The result suggests that it may not be important in the decision of consumption of *ahi poke*. One other variable that was ruled out of the equation was the gender demographic that indicates that it may not contribute to explaining the consumption patterns of *ahi poke*. The same occurred for household characteristics of number of family generations in Hawaii, whether respondents are residents of Hawaii, and number of people per household size. These variables

may have a role in explain general food consumption for Hawaiian consumers but they are not found to be significant to explain *ahi poke* consumption in this study.

As explained previously, the coefficient estimates themselves do not provide easy interpretation of the direction and magnitude impacts from explanatory variables on the decision criteria for consumption. Following expression (8), Table 4 presents the marginal effects of the variables included in the equation.

[Table 4 here.]

Whether respondents eat *ahi poke* at least once a month were significantly less likely to consume if compared with respondents who consume at least once a week, or the other two categories of frequency for *ahi poke* consumption. On average, these individuals consume 1.25 pounds less pounds per month than those that consume at least once a week, at least once a year, or at least once every two years. Looking at the frequencies, one may say that these individuals, on average, consume less *ahi poke* than those that consume at least once a week, due to the low frequencies of the other two categories and this can be an important factor for the market characteristics to be taken in account.

Individuals that have purchased or eaten previously frozen *ahi poke* are likely to consume 0.50 pounds per month more on average pounds per month than those that never purchased or eaten previously frozen *ahi poke*. This may imply that for these individuals frozen product is convenient and available more often at their homes, thus they consume more often than those who do not purchase frozen *ahi poke*. Moreover, individuals that like to prepare their own *ahi poke* from *ahi* blocks/steaks/loins are also, on average, likely to consume 0.53 pounds more per

month than those that do not prepare their own *ahi poke*. One could say that a person may have more meals at home than in restaurants, or that in some cases, people who prepare their own *ahi poke* assume that their meal is fresh than if consumed in another place or prepared by others.

Education proved to be significant in explaining consumption patterns for *ahi poke* and on average one more year of education leads to 0.11 pounds per month less product consumed. One possible explanation is that people with higher levels of education may be more aware of recent warnings on the dangers of eating raw saltwater and freshwater fish because of parasites that can be transmitted to humans such as the larvae of *Anisakis simplex*, a marine roundworm carried and transmitted by saltwater fish such as flounder, cod, haddock, yellowtail and ling (Feldhusen, 2000). In addition, in contrast to the benefits of fish consumption, there are also risks associated with the presence of chemical and biological contaminants in seafood. For example, mercury and its biologically active form, methyl mercury, are thought to be injurious to the developing human nervous system. In addition to its effect on the nervous system, methyl mercury may also counteract the protective effects of omega-3 fatty acids on cardiovascular disease (Dickhoff et al., 2007).

Although the signs for the marginal effects were consistent with the coefficients estimation, income and the quadratic income does not have impact on the consumption, therefore, income appears not being an important drive affecting *ahi poke* consumption, which could be related to the strong traditional aspect in nowadays Hawaiian culture where fish and seafood is considered a staple. Variable White has insignificant marginal effect suggesting that holding other factors constant individuals who are Caucasian descendents are not different to the other ethnic groups

in terms of their *ahi poke* consumption. Dummy variables White and Japan are constructed to compare with the rest of the sample. As shown in Table 1, the rest of the sample is comprised mostly by Native Hawaiian and ethnic groups such as African Americans, Filipinos, Chinese, Korean, Samoan, and individuals with more than one ethnic background are also included. Variable Japan however has a negative significant marginal effect, indicating that on average their consumption is 0.31 pounds less than the comparison group. Although fish consumption is in the Japanese culture, the evidence here in this paper is that for *ahi poke*, individuals with Japanese background do not appear to prefer it in particular. Marketers noticing this observation should evaluate their marketing strategies to attract corresponding consumers.

6. Conclusion

Although there are a number of contaminants including chemicals, metals and other substances, as well as potentially harmful microbes that may be associated with seafood, specially raw seafood, observed from the U.S. consumption data, benefits for the population as a whole appears to have exceeded the health risks (Mozaffarian and Rimm, 2006). This information allied with steps taken to minimize the risk of seafood borne microbial illnesses, and following general food safety guidelines avoiding types of seafood identified as being more likely to be contaminated, should be of significant values to consumers, and may potentially boost new interest for seafood, including *ahi poke*.

Consumption of *ahi poke* is an essential component of the seafood market in Hawaii and a traditional cultural delicacy in its community. However, there has been no reported studies

examine this important product in Hawaii. Using revealed data collected from a consumer survey, this article attempts to first provide an overview of *ahi poke* consumption and then link consumer characteristics to their corresponding level of consumption. A Tobit model analysis suggests that demographic characteristics such as education and ethnicity may explain the quantity consumed. Some evidence shows income not to be a decision factor in purchasing *ahi poke*, marketing alternatives could be studied to aim consumer preferences regarding product freshness and convenience. In addition, consumers' past experience with *ahi poke* also plays crucial role in their consumption decision. It seems that both segments of fresh and frozen products can be captured by the industry, but more research will be required in order to further understand the different attributes that contribute to the choices consumers make in market surrounding tuna. Producers, importers, retailers, and other *ahi poke* marketers could find information revealed in this study useful. With the knowledge of what type of consumers are likely involved, these groups can better target their market strategies with more elucidative information and more specific merchandizing approaches. This study also contributes to understand the social, cultural and economic impacts of *ahi poke* in local Hawaii communities.

A complex information environment influences consumer food choice, and new information such as dietary guidance, may not necessarily make consumers change the way they eat. Seafood choices, like all consumption choices, entail value tradeoffs; some consumers will make high-risk choices to gain what they value as high benefits, while others will avoid the risk. These differences make the task of informing consumers and supporting their decisions challenging. Further studies may incorporate these aspects. For example, consumer guidance should include easy access to information that is presented in a clear and understandable format,

supports decision-making, and gives access to additional information when consumers want it. How would these guidelines interact with the consumption of raw tuna salad which has conventionally been attached with indigenous values could be an interesting research question.

Acknowledgement

Funding from the NOAA Pacific Islands Fisheries Science Center is greatly appreciated.

References

Asche, F., T. Bjørndal, and D. V. Gordon (2007). "Demand Structure for Fish". Handbook of Operations Research & Management Science, 99: 295-314.

Cheng, H., and O. Capps (1988). "Demand analysis of fresh and frozen finfish and shellfish in the United States." American Journal of Agricultural Economics, 70: 533-542.

CNN Money (2009) "Best Places to Live" accessed on July 30, 2009 at http://money.cnn.com/magazines/moneymag/bplive/2009/

Costa, J. A. (1998) "Paradisal Discourse: A Critical Analysis of Marketing and Consuming Hawaii" *Consumption, Markets and Culture* 1: 303-347.

Dickhoff, W. W., T. K. Collier, and U. Varanasi. 2007 . "The Seafood "Dilemma" - A Way Forward". Magazine Article of The American Fisheries Society (AFS), 32-5. May 2007. http://www.fisheries.org

East-West Research Inst. (1989). "Hawaii seafood consumption: a survey of seafood consumption in Hawaii." Contract Rep., State of Hawaii, Dep. Business and Economic Development, Honolulu, Hawaii.

FAO (2008). "The State of World Fisheries and Aquaculture". FAO, Rome, Italy.
Feldhusen, F. (2000). "The role of seafood in bacterial foodborne diseases." Microbes and Infection, 2 (13): 1651-1660.

Greene, W. (2003). "Econometric Analysis". New Jersey: Prentice Hall.

Higuchi, W. K., and S. G. Pooley. (1985). "Hawaii's retail seafood volume." U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-85-06, 16 p.

Hodge, W. G., H. M. Schachter, D. Barnes, Y. Pan, E. C. Lowcock, L. Zhang, M. Sampson, A. Morrison, K. Tran, M. Miguelez, and G. Lewin (2006). "Efficacy of omega-3 fatty acids in preventing age-related macular degeneration: a systematic review". Ophthalmology, 113:1165-1173.

Mozaffarian, D., and E. B. Rimm (2006). "Fish intake, contaminants, and human health. Evaluating the risks and benefits". Journal of the American Medical Association, 296: 1885-1899.

National Institutes of Medicine (2007). "Seafood choices: balancing the benefits and risks". Committee on nutrient relationships in seafood: M. C. Nesheim,and A.L. Yaktine, eds. The National Academies Press, Washington D.C.

National Oceanic and Atmospheric Association (NOAA) (2008). NOAA's Fisheries Service 2007. Accessed on July 23 2009 at http://www.noaanews.noaa.gov/stories2008/20080717_seafood.html

NOAA (2009). Pelagic Fisheries of the Western Pacific Region 2007 Annual Report. Western Pacific Regional Fishery Management Council. Honolulu, HI.

Pooley, Samuel G. (1993). "Economics and Hawaii's marine fisheries". Marine Fisheries Review, 55 (2): p93.

Rose, D. P., and J. M. Connolly (1999). "Omega-3 fatty acids as cancer chemopreventive agents". Pharmacology and Therapeutics, 83:217-244.

Titcomb, M. and M. K. Pukui (1977). "Native Use of Fish". Honolulu, HI: University Press of Hawaii.

U.S. Department of Health & Human Services "Dietary Guidelines for Americans" accessed on July 31 2009 at http://www.health.gov/dietaryguidelines/dga2005/document/

Wessels, C. R., and J. L. Anderson (1992). "Innovations and Progress in Seafood Demand and Market Analysis". Marine Resource Economics, 7: 209-228.

Table 1. Descriptive Statistics of Ahi Poke Study Sample versus the Department of Business, Economic Development and Tourism Population Demographic Distribution.

	Department of Business, Economic Development (2000)*	Ahi Poke Study (2008)
INCOME		
Less than $25K	**23%**	**16%**
$25K-$49,999	**27%**	**21%**
$50K-$74,999	**21%**	**19%**
$75K-$99,999	**13%**	**18%**
$100K-$149,999	**11%**	**18%**
More than $150K	**6%**	**7%**
EDUCATION		
Some college and less	**74%**	**47%**
Bachelor's/Advanced	**26%**	**53%**
AGES: Male		
20 to 29 years	**21%**	**19%**
30 to 39 years	**19%**	**19%**
40 to 49 years	**19%**	**15%**
50 to 59 years	**18%**	**22%**
60 to 69 years	**11%**	**14%**
70 to 79 years	**7%**	**9%**
80 and over	**5%**	**2%**
AGES: Female		
20 to 29 years	**18%**	**16%**
30 to 39 years	**18%**	**14%**
40 to 49 years	**19%**	**13%**
50 to 59 years	**18%**	**28%**
60 to 69 years	**11%**	**17%**
70 to 79 years	**9%**	**12%**
80 and over	**7%**	**1%**
ETHNICITY		
White	**33%**	**27%**
Japanese	**22%**	**30%**
Filipino	**19%**	**6%**
Native Hawaiian	**9%**	**18%**
Other (including those with more than one race)	**17%**	**19%**

Website: http://hawaii.gov/dbedt/info/economic/databook/db2006/ (Accessed June 30, 2008)

Table 2. Descriptive Statistics of Households Characteristics.

Variable	Definition	Mean	Std. Dev.
PMonth	dependent variable; pounds of *ahi poke* consumed per month	2.011	2.974
MAKPOKE	dummy variable; whether prepare *ahi poke* from *ahi* blocks/steaks/loins	0.541	0.499
HARE	dummy variable; if resident of Hawaii	0.93	0.256
FAMG	continuous variable; number of family generations in Hawaii	4.241	4.541
EDUC	continuous variable; level of education in years	15.237	1.95
HHOLD	continuous variable; household size	2.792	1.726
eat	dummy variable; whether respondents eat *ahi poke* at most once a month	0.445	0.498
froz	dummy variable; whether purchased or eaten previously frozen *ahi poke*	0.583	0.494
Male	dummy variable; whether the respondent is Male	0.522	0.5
Japan	dummy variable; whether the respondent is a Japanese descendent	0.304	0.461
White	dummy variable; whether the respondent is white	0.269	0.444
incg	continuous variable; total household income (US$) /10,000	7.052	4.161
Spmkt	dummy variable; purchased *ahi poke* in the Supermarket	0.686	0.465
Oahu	dummy variable; resident of Oahu	0.824	0.381
N=427			

Table 3. Estimation Result of Tobit Model.

Variable	Coefficient	Std. Err.
Constant	3.777***	1.249
eat	-1.631***	0.274
froz	0.634**	0.274
MAKPOKE	0.698**	0.276
incg	0.211	0.15
$Incg^2$	-0.013	0.009
EDUC	-0.135*	0.074
Japan	-0.590*	0.327
White	-0.286	0.338
σ	2.739***	0.094
LL	-1033	
Akaike information criterion	2090	
Schwarz Criterion	2139	

*, **, and *** indicate significant at the 10%, 5%, and 1% significance levels respectively.

Table 4. Marginal Effects of Explanatory Variables.

Variable	Label	Marginal	Std. Dev.
Meff_eat	Marginal effect of whether respondents eat *ahi poke* once a month on pounds of *ahi poke* consumption per month (compared to those who eat more often)	-1.221***	0.211
Meff_froz	Marginal effect of whether purchased or eaten previously frozen *ahi poke* on pounds of *ahi poke* consumption per month	0.475***	0.082
Meff_MAKPOKE	Marginal effect of whether prepare *ahi poke* from *ahi* blocks/steaks/loins on pounds of *ahi poke* consumption per month	0.523**	0.09
Meff_incg	Marginal effect of total household income (US$) ⁄10,000 on pounds of *ahi poke* consumption per month	0.158	0.027
Meff_incg2	Marginal effect of squared total household income (US$) ⁄10,000 on pounds of *ahi poke* consumption per month	-0.01	0.002
Meff_EDUC	Marginal effect of level of education in years on pounds of *ahi poke* consumption per month	-0.101*	0.018
Meff_Japan	Marginal effect of whether the respondent is a Japanese descendent on pounds of *ahi poke* consumption per month	-0.442*	0.076
Meff_White	Marginal effect of whether the respondent is a Caucasian descendent on pounds of *ahi poke* consumption per month	-0.214	0.369

*, **, and *** indicate significant at the 10%, 5%, and 1% significance levels respectively.