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MARKET PREFERENCES, WHOLESALE DEMAND & BREAKEVEN PRICES FOR LIVE MARINE ORNAMENTALS CULTURED AND COLLECTED IN FLORIDA

by

Sherry Larkin, Robert Degner, and Wendy Rubinstein

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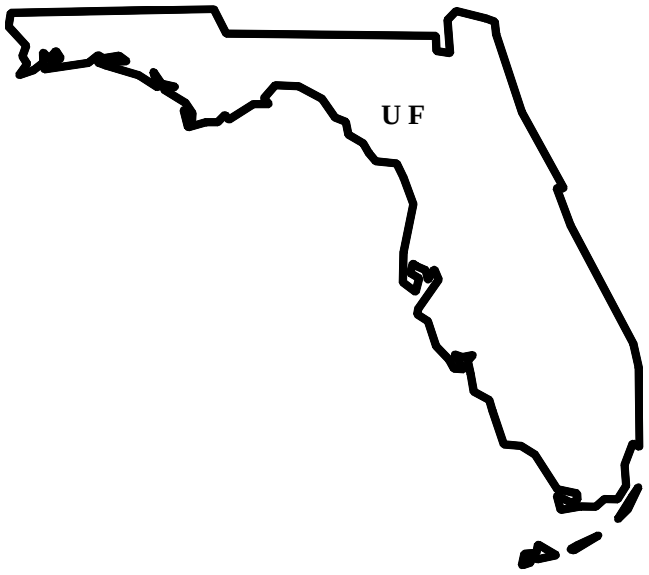

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Market Preferences, Wholesale Demand & Breakeven Prices for Live Marine Ornamentals Cultured and Collected in Florida

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Abstract

Using an innovative internet-based conjoint survey, preferences of firms at various nodes of exchange in the marketing channel for selected attributes of marine ornamentals. Market experiments were conducted for four species, namely: queen angelfish (*Holacanthus ciliaris*), spotfin hogfish (*Bodianus pulchellus*), orange skunk clownfish (*Amphiprion Sandaracinos*), and peppermint shrimp (*Lysmata Wurdemanni*). Preferences were defined in terms of profitability ratings and respondents were asked to provide the purchase interval and quantity demand for all product profiles (24 in total). At least 30 firms completed all market experiments. The identical set of product, firm and respondent attributes was used to explain the profitability ratings, demands, and probability of purchase for each species. Results indicate that there are significant differences between species and the relative importance differs across models (i.e., ratings, demands, and purchase probability), This was especially true regarding MAC-certification, whose effect depended on the firms' familiarity with the program and/or their likelihood of participating.

Key Words

Agsurveys.com, conjoint, ecolabeling, Internet surveys, MAC certification, marine ornamentals

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INTRODUCTION

Ornamental fish are one of the most popular hobbies in the United States; retail sales of livestock exceeded $430 million in 1998 (Fancy Publications, Inc.). In Florida, marine aquarium species are primarily collected from the wild and dockside values have averaged $2.8 million annually (Adams, Larkin, and Lee). And, farm-level sales of freshwater fish total nearly $65 million annually (Florida Agricultural Statistics Service). The hobby also generates significant economic activity in supporting products, which included $323 million for food, $109 million for medicine, and $271 million for equipment in the U.S. in 1998 (Fancy Publications, Inc.). Product distribution is also an important component of the industry; for example, tropical fish are among the top air cargo out of the Miami and Tampa International Airports (Buckley). In terms of trade, the U.S. is a net importer and the trade deficit is increasing. According to the U.S. Fish and Wildlife Service, imports and exports of live ornamental fish and invertebrates totaled $660 million and $182 million, respectively in 1998 (Adams et al.).

The National Sea Grant program has designated increased culture of marine species a priority initiative. This is important to the industry because the sustained commercial potential of many species is unknown. The harvest of wild-caught fish in Florida – since 1990 when official statistics were first recorded – have been dominated by angelfish, hogfish, and damselfish (the top three species by average value); angelfish alone account for nearly 54% of the value of fish landed from 1990-98 (Adams, Larkin, and Lee). Information on the market potential, breakeven prices, and willingness-to-pay for various product attributes are needed to direct culture research, collection efforts, industry programs (e.g., collection method and/or source certification), and marketing promotions in order to remain competitive and increase market share in the growing international marketplace.

Examples of the need for and immediate application of such research results are abundant. Aside from the Sea Grant national initiative on marine aquaculture, the Florida Fish and Wildlife Conservation Commission is charged with setting species-specific regulations such as size limits, daily bag limits and entry restrictions. Such regulations ultimately affect the value of the resource and continually change to meet the needs of the industry. Also in Florida, the approximately 200 freshwater ornamental fish farmers are continually searching for unique species to enhance their product mix. The University of Florida's Tropical Aquaculture Laboratory in Ruskin – providing diagnostic services and infrastructure guidance programs – is a partial reflection of the importance of the industry to the state. Private organizations, such as the American Marinelife Dealers Association, have also invested resources in ascertaining the perceptions of industry members regarding a certification process. Similar studies are also being considered by other

segments of the international industry (P. Holthus, Executive Director of the Marine Aquarium Council). In addition, there were a number of international conferences with focus on aquarium species (e.g., World Aquaculture Society; The International Aquarium Fish & Accessories Exhibition & Conference; and The International Conference on Marine Ornamentals: Collection, Culture, and Conservation).

Given the continuing demand for unique and distinguishing fish characteristics, and the advent of technology that facilitates the maintenance of home aquariums, the potential for diversification – and, therefore, the need to measure the potential market benefits – in collection and culture is great. For example, the recent Florida Tropical Fish Farmers Association's *Guide to Programs & Benefits* includes an article titled "Why Florida Fish?" The article begins by asking "Isn't a black molly from Southeast Asia just as good as a black molly from Florida?" How buyers answer this question, and how they value the difference between fish from the two sources, can determine the long-run success of the industry. The article continues by stating that fish farmers in Florida "most often guarantee that the fish you order will be more robust and more colorful than its foreign-raised cousins." These types of marketing sentiments are not unique to the farm-raised sector. Unfortunately, market information is not available to answer these types of questions. However, recent applications of experimental market surveys provide an excellent example of how the value and 'willingness-to-pay' for differentiated fish products – and supporting value-added attributes such as certification and labeling – can be determined (Teisl, Roe, and Levy; Blend and Ravenswaay; Wessels, Johnston, and Donath; Holland and Wessells; Harrison, Ozayan, and Meyers; Sylvia and Larkin; Lin and Milon; Anderson and Bettencourt; Mackenzie).

The experimental market approach assumes that the products – in this case ornamental fish – are heterogeneous, that is, differentiated with respect to attributes such as species, country of origin, method of capture/culture, size, color, price, and condition. Each attribute is defined by several levels; for example, size can be small, medium, or large. Ornamental fish are, therefore, aptly described as a composite of attributes at different levels. A buyer's (wholesaler's) overall preference for a given product (live ornamental fish) is assumed to be the total utility (profit) the firm will derive from its purchase and resale. However, market data (even if available) could never fully identify the attributes of a product. This is because market data generally contains product price and quantity as if products are homogeneous. Plus, market data are not available on products that are not yet available for sales (i.e., to assess the potential market for a new product). Consequently, the application of traditional demand analysis is inadequate as a tool to address the questions relevant to the ornamental fish industry. Moreover, the large number of marine ornamental species – for example, at least 330 have been collected in Florida since 1990 (Adams, Larkin, and Lee) – and the reluctance of proprietors to release confidential sales information would preclude an effective data collection process.

Conjoint analysis (CA), also known as stated preference analysis, is one such experimental survey-based technique that (1) provides an understanding of product preferences, (2) provides importance measures for attributes, (3) assesses preferences among products, and (4) assists in product design (Meyer). One conceptual difference between CA and other non-market valuation techniques (such as contingent valuation) is

that CA treats price as just another product attribute. Including price as an attribute minimizes many of the biases that can result when respondents are asked to assign a value to a non-market good. In general, CA is appropriate for primary data collection when the market is characterized by heterogeneous products and there is a high degree of market segmentation, minimal available data, and a need to forecast the acceptance of new products (Harrison, Gillespie, and Fields; Holland and Wessells).

As an overview, there are essentially four steps involved in a conjoint study. First, relevant product attributes (e.g., fish size) and their levels (e.g., 1 inch, 3 inches, or 5 inches in length) are defined. Second, an experimental design is constructed to collect the data. This step involves using the attributes and attribute levels to construct hypothetical products and determining how many and which products each respondent will evaluate. In the third step, respondents (i.e., wholesalers of ornamental fish in this study) are asked to evaluate the attributes, attribute levels, and hypothetical products. The evaluations are typically in the form of a rating or ranking on a predefined scale (e.g., -10 to +10 or 0 to 100). Lastly, statistical techniques are utilized to analyze responses and estimate preference models. Using these models, it is possible to test the relative contribution of the individual attributes and attribute levels to firm profitability and probability of purchase. The models can also be used to derive breakeven prices and estimates of expected demand. Consequently, this study would provide (1) an innovative application of CA and (2) market information needed by ornamental fish producers and wholesalers to compete successfully in the 21st century.

Traditionally, stated preference surveys have been conducted as personal interviews or by mail (Meyer). Due to the nature of the CA questions – respondents must compare multiple product profiles – stated preference surveys cannot be conducted by phone. The growth of the Internet provides a new approach to conducting CA surveys. Advantages to this approach include (1) the ability to use color graphics (which can be prohibitively expensive for mail surveys), (2) higher completion rates (since blank responses can trigger "pop-up" reminder boxes), and (3) low cost (eliminates need for costly personal interviews or unanswered mail-outs) (Meyer). Disadvantages of conducting a web-based interview include (1) attracting respondents to the site, (2) non-representation by firms without Internet access, and (3) verifying the credibility/authenticity of the respondents. Fortunately, a number of steps can be taken to address the disadvantages.

The remaining issue to address is the source of potential respondents. The Florida Department of Environmental Protection (FDEP) provided a list of licensed dealers of marine ornamentals. In 1997 and 1998 there were approximately 125 wholesale licenses with reported landings (these include individuals and businesses). The largest wholesalers of aquarium species are also listed in the annual *PPN Buying Guide Directory* (Fancy Publications, Inc.). In 1998, this directory included approximately 120 entries (20 were previously included in the FDEP list). A list of additional wholesalers was obtained from the Florida Tropical Fish Farmers Association (FTFFA). In 1998, the FTFFA directory included 175 firms. International firms were identified through industry organizations such as the Singapore Aquarium Fish Exporters Association (SAFEA), Ornamental Fish

International (OFI), and Ornamental Aquarium Trade Association (OATA) and various web sites that list foreign and domestic firms.

To reach potential respondents, post-cards and emails were sent to individual firms. Additionally, letters were sent and phone calls placed to professional organizations (e.g., the *PPN Buyer's Guide Directory* includes the email addresses of 76 U.S. wholesalers and all 37 members of an Indonesian aquarium fish trade association lists web addresses). Second, given the number of organizations that have websites and links to member firms, the relatively small sample size is not perceived to be a problem. The diversity of the sample was confirmed through answers to demographic questions. It is believed that the Internet survey reached all the major firms (especially foreign firms that would otherwise be omitted). Lastly, to assure the legitimacy of responses, a unique username and password was required to enter the survey site. This information was included in the invitation to participate in the survey (through a postal mail letter to everyone and through follow-up postcards and emails. This approach prevented "saboteurs", i.e., unauthorized visitors who learn about the survey or accidentally find the survey page, from entering the survey site since it was highly unlikely that they could guess the randomized three-digit username and corresponding four-digit password. An additional advantage of having the email address was that it allowed for a follow-up "thank you" to the respondent that was both timely and very inexpensive.

Once the respondents began the survey, responses were 'submitted' when the respondent moved to the next 'page'. The survey questions were organized into a series of pages such that data could be received in stages. The advantage to this approach was that usable data were obtained from partially completed surveys (e.g., if the respondent became interrupted or did not want to continue). Once submitted the responses were appended to the end of a comma separated variable file that also recorded the time and date. The results file for each page was continuously available for download only to those individuals with designated access for that file.

Another advantage of an Internet survey is the ability to track "hits," that is, a list of the email addresses that viewed each page was obtained. Also, the time and date information on each page can be used to determine the length of time required to complete each page. This information can be very useful for assessing the success of the site. If, for example, respondents did not finish the survey after a certain page, it may indicate a problem with the questioning or format.

The remainder of this report begins with an overview of ecolabeling programs, including the newly-establish Marine Aquarium Council (MAC) certification, and studies of their effectiveness. Ecolabeling is, in general, the practice of placing a label on a resource-based product that ensures that the environment (including the stock) that supports the resource has not been adversely harmed (or that harm has been minimized) by the harvest, transport, and/or handling of the stock. In recent years, several such programs have been initiated and several studies have examined their success or potential success. Given the initiation of such a program for marine ornamentals (i.e., the MAC certification), examining the profitability, perceived break-even prices, and potential demand for MAC-certified specimens would be important to firms contemplating participating in the program (especially since program costs are unknown). Following the

overview of ecolabeling, the specific objectives of this study are presented. Then the survey instrument is described. Prior to the empirical modeling, the model specifications are outlined. Lastly, results are presented and discussed.

ECOLABELING

The concept of developing certification standards and certified labeling for various products is not new. In 1977 Germany established the first certification seal of approval (Wynne). "Blue Angel" was the first environmental seal for products proven to have positive environmental features (Bartenhagen). The Blue Angel program is a cooperative effort among several independent organizations, governmental bodies and the public. The entities develop a set of criteria that promote environmental soundness in various products. Applicants must pay a fee to have their products tested to determine whether they meet these criteria. Applicants meeting the criteria may display the seal of approval. To date, the German ecolabeling program has certified approximately 4,000 products (http://www.buygreen.com/main/guide.htm). Ecolabeling usage has since expanded throughout the world, and across various industries. The marine industry is one of those industries.

Today, certification programs are primarily found in market-based systems that substantiate claims of compliance with various criteria. Proponents contend that the implementation of a certification system for marine ornamental trade will promote sustainable collection and fishing practices (MAC Newsletter). This is because the market-based approach effectively shifts the burden of compliance from the government to the private sector and society. Certification has the potential to be an important tool for promoting environmentally sustainable practices, if monitored correctly. Many attempts at certification programs fail because of a lack of trust from the public. In some industries, such as ecotourism, attempts at establishing a certification standard results in a lack of consistent worldwide or regional standards. In the ecotourism example, many groups were offering certification programs or guidelines to follow, but these guidelines varied widely. If there is a lack of measurable parameters or a lack of universal standards, it becomes possible for companies to take advantage of the eco-friendly certification label (http://www.turismo-sostenible.co.cr/EN/sobreCST/when-why.shtml). This results in "green washing;" the unverifiable claims of eco-friendliness that offer no meaningful environmental benefits (Wynne). Green washing in the marine ornamental industry could have disastrous effects on conservation efforts, because a lack of faith in the certified industry results in a lack of demand for the higher priced good.

Forest Certification

The forestry industry is perhaps the most successful example, to date, of an international certification program. As the world population continues to increase, more demands are placed on the world's forests. For some, forests provide a sole means for survival. For others, it provides additional wealth. Because of the income potential, illegal logging on

forestlands is next to impossible to stop and it becomes increasingly important to attempt to control. While "many of the world's forests are being flattened by the footsteps of human activity... some areas of forests are being well-managed in ways which benefit the environment and people" ("Certification: A Future for the World's Forests", http://www.panda.org/resources/publications/forest/cert/cert_intro.html). The question that begs for an answer is how can consumers tell which forest their purchased product comes from. The certification program answers this question for us.

A key step in preserving forests is for consumers to ensure that their purchases support companies who remove timber in an environmentally sound way so as to limit the negative impacts. By implementing a certification program, consumers will have the information available to ensure where a product came from, and the management practices employed to remove it from its natural state.

The Forest Stewardship Council (FSC) is the most widely recognized certification organization in forestry (www.forest-trends.org/keytrends/trends_mgmtgovcert.htm). The FSC is an international non-profit organization. Founded in 1993, the FSC's mission is "to support environmentally appropriate, socially beneficial, and economically viable management of the world's forests" (www.fscoax.org/principal.htm). The non-profit's members come from a diverse group of representatives from such areas as environmental and social groups, organizations representing indigenous peoples, community groups, forestry and timber trade professionals, and forest certification organizations. Furthermore, membership is available to all people in the forestry profession who share the same mission as FSC.

FSC introduced its international labeling scheme in order to provide a trustworthy guarantee that a product comes from a well-managed forest operation. Important to note, FSC employs a third party to verify compliance with its economic and social criteria (and thus avoids claims of green washing). Additionally, the FSC encourages "the development of national and local standards that implement the international Principles and Criteria of Forest Stewardship at the local level." To further assist the efforts of working groups through this process, FSC developed guidelines for developing regional certification standards.

The FSC certification program has had positive effects on the industry, and the number of forestry operations and the worldwide acreage that is FSC certified is growing rapidly (see various issues of Forest Trends). Furthermore, the certification program provides a market-based incentive for good forestry stewardship. More and more retailers are stocking FSC-certified wood, such as the Home Depot and Lowe's, and demand is outstripping supply for certified products. Therefore, consumer preference for environmentally friendly operations and FSC certification program created a new market in forestry products that treads more softly on the environment.

Fisheries Certification

Like the FSC, the Marine Stewardship Council (MSC) aims for sustainable marine fisheries by promoting responsible, environmentally sustainable, socially beneficial and economically viable fisheries practices. In order to ensure that its defining Principles and

Criteria would be internationally relevant and applicable, the MSC convened a workshop of experts from fields such as fisheries economics, stock assessment, marine ecosystem analysis, conservation groups, and experts from the social and legal disciplines of fisheries in September 1996 (www.msc.org/html/content.htm?content_39.htm). Drawing upon several formal and informal documents such as the Code of Conduct for Responsible Fisheries (United Nations Food and Agriculture Organization) and the United Nations Agreement on Straddling Fish Stocks, the participants drafted the "Principles and Criteria." The MSC then held further international workshops in order to get input from stakeholders representing industry, regulators, processors, retailers, consumers, and fishers. The first public draft of the Principles and Criteria for Sustainable Fishing were then presented to the MSC board in December 1997.

Such extensive means were used to develop the Principles and Criteria for Sustainable Fishing because they became the standards for a third-party, voluntary certification program. They emphasize that in instances of full cooperation among all of the fisheries stakeholders, the key to accomplishing conservation goals and sustainable use of marine resources is proper management. The Principles further consider that sustainable fishery depends upon maintaining and re-establishing healthy populations of targeted species, maintaining the integrity of ecosystems, developing "effective fisheries management systems, (taking into account all relevant biological, technological, economic, social, environmental and commercial aspects), and" complying with all relevant local and national laws, standards, and international pacts.

The certification program is available to all fishery operations, regardless of size, although size is one of the variables considered during the certification process. The program is voluntary, and run by independent, MSC-accredited, third-party certifiers. Although the Principles and Criteria apply only to wild-captured fisheries at this stage, and to activities up to but not beyond the point at which the fish are landed, MSC hopes to encourage processors, traders and retailers "to make public commitments to purchase fish products only from certified sources." This will help consumers make informed choices about which products to buy, and provide market incentives for fisheries to employ sustainable practices. Therefore, consumer preference for environmentally-friendly operations and the MSC certification program help create a new market in fishery products, like the FSC and forestry products, that treads more softly on the marine environment.

Food Certification

Australia-New Zealand

Certification standard systems are not employed solely to protect ecosystems and biodiversity; rather, standards and guidelines are also used as a human safety seal. The Australian-New Zealand Food Authority (ANZFA), for example, has Food Safety Standards (FSS) ("ANZFA Food Safety Standards and how they will impact on your business," www.wa.gov.au/westfish/sqmi/about/about03.html). The ANZFA formulated the FSS in order to provide all of Australia with a consistent framework on matters of food safety. FSS became effective at the end of 2000. The program made mandatory

standards that require all food businesses to "notify themselves to a relevant authority;" they must also "provide for food recalls; ensure staff have the competencies in food hygiene commensurate with their work activities; and abide by standards which set out good manufacturing practice for food handling, storage, premises and equipment."

Although these standards are mandatory, legislation is not in place to enforce the standards. Instead, commercial factors demand compliance. As in forestry with large retailers demanding FSC certified wood, large retailers are demanding FSS-certified products. For example, many of the supermarket chains and the Sydney Fish Market demand products that meet the criteria "which can only be proved by a food safety plan." Therefore, in order to meet the conscientious consumer demand, the food businesses must comply with the FSS in producing the supply.

The next step in the road to certification in fishing, aquaculture and related industries in Western Australia passes through the Seafood Quality Management Initiative (SQMI) (www.wa.gov.au/westfish/sqmi/about/index.html). SQMI seeks to develop a management system that encompasses a complete chain of custody, from harvest to the customer, in order to strengthen Western Australia's position as a producer and exporter of high quality marine products. Therefore, they developed a "Quality Assurance Guidebook" in order to assist producers in implementing a management plan, following the Food Safety Standards, and achieving certification (www.wa.gov.au/westfish/sqmi/qaguide/qaguide08.html).

Tropical Agriculture

Developing nations find it more difficult to use sustainable practices in agriculture than developed nations. Agriculture in these underdeveloped areas is extremely important in contributing to the world's food supply and is an integral part of that nation's economy. It provides products for export, domestic employment, and a means for foreign investment. These everyday products of tropical agriculture, such as bananas and coffee, negatively affect the environments of the producing nations. Some of these negative impacts include, but are in no way limited to, effects of using high levels of pesticides and fertilizers, conversion of rainforests into cultivated lands, displacement of wildlife, water pollution, and unsafe working conditions. Instead of supporting the boycotts of these tropical commodities, The Conservation Agriculture Network (CAN) "promotes incentives for farmers to transform tropical agriculture production" in order to make it less damaging socially and environmentally (www.rainforest-alliance.org/programs/cap /program-description.html).

CAN is a network of independent, nonprofit conservation groups throughout the Americas that developed a certification program in order to reduce the damages of tropical agriculture. CAN consults with various social and environmental groups, industry, and government in order to develop guidelines for well-managed tropical agriculture which are sensitive to and balance between the various needs of all the parties aforementioned as well as the community's. The network's "mission is to transform the environmental and social conditions of tropical agriculture through conservation

certification" (www.rainforest-alliance.org/programs/cap /principles.html). In order to accomplish its mission, CAN proposes the following solutions:

- Develop practical, concrete and measurable guidelines for reduced- impact farming;
- Reward growers who meet the socio-environmental standards by encouraging consumer demand for certified products;
- Reduce environmental impacts and improve social conditions on farms;
- Conduct ecological and social research;
- Provide environmental education to farm managers, workers and their families; and
- Provide a forum for community input on the impacts of agriculture.

To date, CAN has had a positive effect in several countries and in various tropical products. For example, CAN has positively affected banana farming on Costa Rica since 1991. Furthermore, its banana certification program (ECO-O.K.) received the Peter F. Drucker Award for Nonprofit Innovation in 1995; ECO-O.K. was the first conservation program to receive this award. Enrollment in the program is increasing with 25% of Costa Rican production and 41% of banana production in Panama awarded certification, as well as farms in many other countries. CAN also has certification programs specifically targeted to coffee, citrus, and cacao production as well as a new crops certification program.

Marine Ornamentals Certification

Like the forest industry, the tropical agriculture industry, or the seafood industry, a certification system can also be applied to the marine, non-food industry so that consumers can make a well-informed choice in purchasing marine ornamentals products. Similar to the rainforests, coral reefs are home to an infinite number of marine organisms. Reefs are crucial to the survival of these species and to the preservation of biodiversity in the oceans. Therefore, increasing coral reef destruction as a byproduct of the marine ornamental industry has received increased attention (e.g., The Year of the Reef campaign). While it is easy to say that a certification system is applicable, several goals must be met in order to be successful:

- An international criteria must be set and then translated into regional and national contexts;
- An independent inspection and certification system must be established;
- A means of tracking the product through a chain of custody from source to final sale to consumer must be created;
- And the industry must be convinced to revolutionize its way of doing business and open its supply chain to outside inspection.

History

The American Marinelife Dealers Association (AMDA) sponsored the initial initiative to promote sustainable standards of practice in marine ornamentals. The AMDA is a non-profit organization whose mission is "to promote environmentally responsible marine aquarium keeping as an entertaining, educational, and worthwhile leisure time activity."

AMDA's goals are to establish a network of retail establishments who follow AMDA Standards of Practice; to raise awareness of the marine ornamental industry's role in conservation; to make available the latest information on good animal husbandry practices; and to support commercially cultured organisms as an alternate for wild caught species (www.amdareef.com/frame_main.htm). AMDA promotes "sustainable trade in living marine organisms for aquariums" by giving collectors who engage in sustainable harvesting of marine organisms financial incentive to protect the ecosystems that provide their livelihood. AMDA developed a "Standards of Practice" in 1998, which are the "standards that the American Marinelife Dealers Association members pledge to abide by, in order to promote environmentally responsible marine aquarium keeping" (www.amdareef.com/standards.htm).

These standards of practice call for members to ensure the welfare of the fish. This requires a record of mortalities for particular batches. In addition, members must keep animals in adequate accommodations. Holding systems must be monitored daily "and cleaned as often as necessary to maintain good hygiene standards." Additionally, the animals should be offered food regularly, and water quality should be checked regularly as well.

In addition to standards applying to all member establishments holding marine species, there are specific standards for collectors. Some of these responsibilities include using legal and non-damaging techniques when collecting specimens. Collectors must also receive proper training in captive techniques. Furthermore, a "verifiable 'chain of custody'" should be maintained. The chain of custody, or the supply chain, is a record of fish bought and sold, except retail sale, including information on source and destination.

Importer/carriers also subscribe to special responsibilities. They must demonstrate that they follow the minimal guidelines. These guidelines provide that fish are packed in such a way that they will survive 48 hours in transit, and designates duties and standards of care for handling these shipments.

Wholesalers are then responsible for unpacking these shipments. Unpacking responsibilities include promptly unpacking the live shipment, in dim lighting conditions, acclimatization, and maintaining a trained or experienced staff. Additionally, a wholesaler must be able to handle fish specimens in distress and preventing or controlling the outbreak of diseases. Records of the disease outbreaks must be kept. Moreover, wholesalers should not buy specimens that they witness have a dismal survival rate in captivity.

Retailers have many of the same responsibilities as wholesalers, such as unpacking and acclimatization techniques. Retailers must additionally keep records of fish purchases and mortalities. Retailers cannot offer specimens that will not survive in captivity and should offer "captive raised specimens (when available) rather than sell wild stock." This requirement contributes to the demand for commercially cultured marine ornamentals, thereby ensuring a market. Furthermore, retailers must also subscribe to the various requirements for sales to the public as well.

The AMDA's Standards is the equivalent of a certification program. Members agree to abide by these standards; and in return, their business is associated with AMDA. Thus, this is a win-win situation in which members benefit, and AMDA promotes the

conservation of natural marine habitats. Because of AMDA's work, conscientious consumers can ensure they are supporting a conscientious producer. Therefore, membership is like a seal of approval from AMDA and its supporters.

Although these standards promote the conservation of the habitat, responsible harvest, and the sale of tank-raised specimens rather than wild caught specimens, these standards are too general. In addition, there does not appear to be a third party enforcer.

MAC Certification Initiative

The Marine Aquarium Council (MAC) is an independent, non-profit organization with headquarters in Hawaii. In order to fulfill its mission, MAC is initiating an international certification system. According to recent MAC Newsletters, certification would ensure quality and sustainability in the collection, culture, and trade of marine ornamentals. MAC's mission "is to conserve coral reefs and other marine habitat by creating standards and educating and certifying those engaged in the collection and care of ornamental marinelife from reef to aquarium" (www.aquariumcouncil.org/aboutm.html). Furthermore, MAC seeks to implement this Mission by completing the following objectives:

- Establishing independent certification process for those in the industry that meet best practice standards.
- Raising public awareness of the role of the marine aquarium industry and hobby in conserving coral reefs.
- Assembling and disseminating accurate data relevant to the collection and care of ornamental marinelife.
- Promoting the sustainable use of coral reefs through the responsible collection of ornamental marinelife
- Ensuring the health and quality of marinelife during transport.
- Encouraging responsible husbandry by the industry and hobby through education and training.

Paul Holthus, executive director of MAC, believes that, ideally, the certification program should cover the entire chain of custody in the aquarium business (Bolido). Therefore, it is necessary to also include a "good harvest practices" certification in the aquarium trade. Holthus also believes that the time is ripe for these guidelines and standards because exporters, importers, wholesalers, and retailers are beginning to see that the coral reefs are dying with the current methods, thereby destroying the potential for future survival of species that currently provide profits. Since MAC is comprised of anyone who wants to contribute to the MAC Mission, it brings together representatives of the aquarium industry, hobbyists, conservation groups, government, etc, and therefore feels the pulse of the industry.

In July 2001, MAC published its first issue of standards to be used for guidance for third party certification of marine aquarium trade. The certification standards are global in scope and split into two phases. The first phase includes the core standards, which were published in July in order to address the immediate need for certification.

The second phase was more thorough and consists of the "Full Standards", which were released in November 2001.

The core standards consist of three documents: "Core Ecosystem and Fishery Management International Performance Standard for the Marine Aquarium Trade" (EFM), "Core Collection, Fishing, and Holding International Performance Standard for the Marine Aquarium Trade" (CFH), and "Core Handling, Husbandry, and Transport International Performance Standard for the Marine Aquarium Trade" (HHT). Along with theses Core Standards, MAC published accompanying Best Practice Guidance documents to provide advice to the party seeking certification on the specific actions that they may take in order to improve their ability to follow the standards. These six documents will be effective until they are replaced by the completed Full Standards and accompanying Best Practice Guidance documents, which are due July 2002. However, MAC expects the core standards to be effective until July 1, 2003, at least. The Full Standards will consist of four documents, the full standards of the previous three core documents and a Mariculture and Aquaculture Management (MAM). Each of these four documents will be accompanied by a Best Practice Guidance document.

MAC sought to address all aspects of the marine aquaculture industry. The initial standards are broad. The scope of the EFM standard covers "the management of the marine ecosystems where fish, corals, and other marine invertebrates, and plants are harvested through non-destructive means for the marine aquarium trade and the management of the stocks of these organisms," This includes the collection area, ecosystem, fishery management, and conservation.

The purpose of the CFH standard is to ensure that the collection, fishing, holding, pre-exporter handling, packing, and transporting of the organisms uphold the integrity of the collection area ecosystem, the sustainability of the fishery, and the health of the organisms harvested. The HHT standard addresses the husbandry, holding, packing, and transport of fish, coral, and other marine invertebrates, as well as plants for marine aquarium trade, while ensuring the optimal health of these organisms.

An international consultation process produced these standards. The Core Standards were initially drafted as a result of several rounds of discussion and revision by an international Standards Advisory Group (SAG), comprised of stakeholders from various sectors of the industry. The draft then became available for public review, revised accordingly, and then revised again by the SAG. These core standards are to be used for a series of test certifications, and the feedback from these tests will be reviewed at a MAC Certifiers Workshop in the future.

STUDY OBJECTIVES

The overall goal of this project is to determine wholesaler preferences for ornamental fish from Florida using an experimental market approach based on "stated preferences." Specific objectives include:

1. To collect preferences regarding marine ornamentals of firms located along different stages in the distribution chain in the United States and abroad using an innovative internet-based market experiment.
2. To quantify the importance of ornamental fish attributes (e.g., species, size, color, price, source, collection technique, etc.) to wholesalers worldwide.
3. To test whether the variation in overall relative profitability rating and quantity demanded of a given product (i.e., marine ornamental fish) is explained by the products' attributes and/or characteristics of the firm (e.g., geographic location, firm size, experience with ornamental fish, etc.). Also, using the profitabilities and quantities demanded as proxies for rankings and choices, we will be able to estimate the probability that a product will be purchased.
4. To calculate breakeven prices, price premiums, and expected demand for various products, attributes, and market segments.

SURVEY INSTRUMENT

Content

CA begins with the identification and definition of the relevant product attributes and attribute levels that are consistent with the buyer's understanding of the product. The paramount question is which species to include. This is because the corresponding attributes and attribute levels will be species-specific. Four types of species were selected: clownfish, shrimp, angelfish, and hogfish. These species represent farmed, cultured, and collected marine species that have distinct characteristics and face competition from foreign imports. Clownfish are one of only a few marine species that are cultured domestically. Cultivation of marine shrimp (e.g., peppermint shrimp) was the subject of a recently completed Florida Sea Grant project (Lin). Angelfish and hogfish are the two highest valued marine species collected in Florida (in terms of average annual sales 1990-98; Adams, Larkin, and Lee). Additional characteristics included size, price, color, and source. Information for the specification of the levels was obtained from the landings data, Internet sites that sell these species, and knowledgeable industry members. To assess the importance and willingness-to-pay for a certification program – one where producers/farmers guarantee the product source and collection method – an additional binary characteristic for the certification process was defined. This 'attribute' reflects the Marine Aquarium Council certification program launched December 2001. Each component of the survey data (i.e., background information, species selection, and the product attributes) is described below.

Background Information

The background information collected first asked whether or not the firm sells non-aquatic products, dry aquarium goods, provides tank maintenance services for hire, and whether or not the firm collects its own marine fish. The next set of questions asked whether or not the firm sells collected and or tank-raised marine and or freshwater fish

(or whether the respondents knows if the fish were collected or tank-raised). Respondents were also asked to specify how many marine species their firm handles over the course of a year (on average) and, of those, how many are tank-raised (i.e., aquacultured) and whether they use 'tank-raised' as a marketing tool. To further distinguish among marketing strategies, respondents were also asked if they always purchase from the same suppliers and if they receive price discounts for large orders. To identify firms by size, respondents were asked to indicate the range that included their total sales of marine fish in 2000 (5 ranges were defined). Then respondents were asked to indicate (i.e., yes, no, or not sure) if they purchased each of the four species included in the conjoint portion of the survey (see next section) in the previous year. To identify firms by position within the marketing chain, respondents were asked to state whether their primary function is one of the following: trans-shipper/distributor, wholesaler, retailer, or 'other'. Given the nature of the aquarium industry, the other category likely includes service-oriented firms (e.g., leasing and maintenance services).

Since the relative desirability of a product will depend on it's price, which will vary by location depending on different transport costs, respondents were asked to indicate the geographic regions where the firm has collecting, holding, and or shipping facilities; 10 regions were defined in total and respondents were asked to identify all that apply.

Two questions were included to characterize the experience and responsibilities of the respondent. The first asked the number of years' experience the respondent has in the aquarium industry. The second asked the respondent to identify all of their current responsibilities within the firm among a list of seven total including: collector, warehouse manager, buyer, sales manager, office manager, president or other officer, and or other.

The final questions concerned the MAC certification program, which had just been proposed at the time of the survey. The first asked how familiar the firm was with the new MAC certification program (i.e., unfamiliar, slightly, moderately, or very). The second asked how likely the firm was to use the program in the future (i.e., not at all, somewhat, or very).

Species

Aquacultured specimens are the only alternative to wild caught marine ornamentals. Thus, aquaculture can help to ensure supplies for the hobby industry and conserve populations in the world's reef environments. Peppermint shrimp (*Lysmata Wurdemanni*) was chosen, in part, because it was the first successful cultured invertebrate (Riley). Additionally, peppermint shrimp cultivation was also the subject of a recent Florida Sea Grant Project and commercial production is beginning (Lin). This particular species of shrimp can be found in "hard coastal substrata such as rock jetties and outcroppings, piers and buoys, and with tubular sponges" occurring from New Jersey down through the Gulf of Mexico and the Caribbean (Riley). The peppermint shrimp, although attractive, is inconspicuously colored. The species is light pink to red in color, while the body of the shrimp has darker, red stripes.

Peppermint shrimp cultivation is attractive since the adults produce eggs every 10-12 days, year-round. Clutch size varies from 579-1707 eggs at each spawning and it only takes 9-11 days for the eggs to mature. Although the survival rate is relatively low (i.e., 22%) from spawning to metamorphosis, few shrimp are lost after metamorphosis. The species is very hardy even though they typically do not exceed 2 inches in length. Retail prices can range upwards of $8 each.

Clownfish are important to the study because they are one of the few tropical marine species cultured domestically. The orange skunk clownfish (*Amphiprion Sandaracinos*) is one of five species of the "skunk" complex. The orange skunk is distinguishable by its mid-dorsal white stripe, and its lack of any other head or body stripes. The species is extremely hardy in aquariums and their unique orange color, non-aggressiveness, and relative rarity also contributes to their popularity.

In the wild, the orange skunk clownfish can be found living amongst the tentacles of large sea anemones along the Atlantic coasts from South Carolina down to Florida, and from the Bahamas and the Florida Keys to South America (Lawrence and Harniess). In the ornamental fish market, clownfish are one of the few species of marine fish that are being cultured successfully. At the retail level, the orange skunk clownfish are usually grouped into three sizes. The small clownfish typically ranges from ¾ to 1 ¼ inches and retails for approximately $10.00. The medium-sized orange skunk clownfish retails at an average $13.00 per fish, and ranges from 1 ¼ to 2 ½ inches. The average retail price for the large clownfish is $15.50 and ranges from 2 ½ to 4 inches.

According to Larkin et al. (2001b), angelfish and hogfish are the two highest-valued marine species groups collected in Florida; average prices and landings are shown in Table 1 for 1990 through 1998. Furthermore, these species groups also accounted for a majority of the specimens landed during this same time. Therefore, information on these two species is invaluable for Florida trade.

Table 1. Average Dockside Price and Landings of Angelfish and Hogfish in Florida, 1990-98

	Angelfish		Hogfish	
	Price ($/each)	Landings	Price ($/each)	Landings
1990	5.62	71,459	7.43	8,535
1991	7.00	82,589	6.56	8,794
1992	6.61	86,711	4.01	9,888
1993	9.13	79,782	8.84	10,112
1994	8.85	82,668	9.23	13,494
1995	6.92	73,666	7.28	12,451
1996	7.61	60,602	7.89	10,633
1997	8.54	59,817	8.23	7,869
1998	8.12	48,839	8.44	7,419
Average	$7.60	71,793	$7.55	9,911

The queen angelfish (*Holacanthus ciliaris*) is the most common angelfish species landed in Florida (Larkin et al. 2001b). In the wild, queen angelfish are found in the tropical Western Atlantic, including the Southern Gulf of Mexico and Florida's Gulf coast. It is especially common along the shallows and reefs of the Florida Keys and is most abundant in the Caribbean islands. This species from the family Pomacanthidae can also be found around shipwrecks and other areas where it can find shelter and food.

The queen angelfish is very distinctive in color. The appearance and coloring of the juvenile queen is also quite different from the adult queen. The juveniles are dark blue, have a yellow tail, and a yellow area around the pectoral fins. As the juvenile queen grows larger, it loses both of these characteristics and their color changes gradually from dark blue to iridescent blues and yellows. As an adult, the queen's length may measure up to 18 inches, and may weigh up to 3.5 lbs.

The retail price for the queen angelfish, like clownfish, varies according to the size of the fish. The small queen ranges in size from 2 to 3 ½ inches, the medium is 3 ½ to 5 inches, and the large is 5 to 7 inches. The average retail prices for small, medium, and large queen angelfish were approximately $65, $90, and $120, respectively, in early 2001.

The spotfin hogfish (*Bodianus pulchellus*) is in the family Labridae and is commonly known as the Cuban hogfish. This species is the most common hogfish landed in Florida. It is found in the Western Atlantic and ranges from the Bahamas and the Keys to South America. It is a deep-water fish, as it is usually found at depths below 80 ft. (Axelrod, Burgess, and Emmens). Furthermore, the spotfin prefers rocky hiding places and usually dwells along coral reefs.

The young spotfin hogfish is yellow in color with some spotting. It begins to change colors when it is approximately 2 inches long. As the fish grows, it develops the characteristic red, white, and yellow markings. The adult fish usually attains a mostly red color and grows up to 8 inches. Important to the marine ornamentals industry, the spotfin hogfish is known for being a hardy fish. As with the orange skunk clownfish and queen angelfish, the market for spotfin hogfish is delineated by fish size. The small spotfin hogfish, ranging from 1 to 2 ½ inches, retailed for approximately $40 on the Internet in early 2001. The average price of the medium spotfin hogfish, ranging from 2 ½ to 4 inches, was $55. Ranging from 4 to 7 inches, the large spotfin hogfish retailed at $70.

Product Attributes

After selecting the species, the next step was the identification and definition of the relevant product attributes and attribute levels. Four attributes were selected in total but each species was described using only three. One of the three was price, which was an attribute for each species. Three price levels were used for each species in order to capture (potential) non-linear price effects. The price levels used were intended to reflect a range of wholesale prices. Given there are multiple wholesale market levels (Larkin et al. 2001a), the prices were set at two to eight times the dockside prices (which were at the low end of wholesale prices advertised on the Internet).

The second attribute selected was "source", which was defined two ways. For the queen angelfish and the spotfin hogfish, the source referred to whether the fish was harvested, transported, and handled using sustainable practices as proposed under the Marine Aquarium Council's certification program. All products were assumed collected from the wild so the MAC-certified fish was assumed to reflect a more sustainable source of supply. For the peppermint shrimp and orange skunk clownfish, three sources were defined: collected from the wild, collected from the wild and MAC-certified, or tank-raised (i.e., cultured). These distinctions will allow for the determination of price premiums (if any) for ecolabled and tank-raised fish.

The third attribute pertained to whether the seller offered a survival guarantee. This type of warranty is relatively common, especially on low-valued species. This attribute was only used to describe the peppermint shrimp and the orange skunk clownfish. This attribute was included to account for the survival rate effect of MAC-certification. In other words, since a survival guarantee may reduce the benefit of handling MAC-certified specimens, the inclusion of a variable that specifically accounts for the survival of the fish may provide a more realistic measure of the benefits of handling MAC certified fish. That is, MAC-certification and survival guarantees could be substitutes.

The final attribute was fish size. This attribute was found to be most prevalent among the angelfish and hogfish species due to their availability and age-dependent color. For each species, three sizes were defined in inches (a range of inches, as presented earlier, for each). Sizes were determined following a review of Internet retail sites. Although each of the species is occasionally marketed in even larger sizes (i.e., four or even five size ranges), this study was limited to three in order to reduce the reporting burden on respondents.

Design

Using all combinations of the attributes and levels would result in an unmanageable number of "product profiles" (e.g., 3 attributes with 3 levels each would produce 27 profiles, too many for each respondent to evaluate, especially for each species). Using an orthogonal array, the total number of profiles can be reduced to the number necessary for empirical estimation (the technique eliminates combinations that are perfectly collinear and would prohibit estimation). Using the SAS statistical program and available macros, 6 profiles were created for each species. These 24 profiles are summarized in Table 2.

To collect the quantitative data needed to fulfill the objectives, respondents were first asked to rate the importance of each attribute to their purchasing decision on a scale of 1 (not important) to 5 (very important). These results provide attribute weights that can be used to explain the relative importance of each attribute to the purchase decision. Objective 2 also proposed asking each respondent to rate the desirability of each attribute level using a similar scale. However, since the desirability of each attribute level would have to be assessed for each species, the reporting burden was considered too great. That is, the additional time required of the respondent to evaluate each level of each attribute for each species was considered prohibitive when compared to the desire to have the

respondents complete the survey within 20 minutes. In addition, this exercise would be very monotonous and could detract from the key elements of the survey. For these reasons, the importance/desirability of the attribute levels by species were excluded from the survey.

Table 2. Product Profiles Evaluated by Respondents

Species	N	Source[a]	Price	Guarantee[b]	Size[b]
P. Shrimp	1	Tank-raised	$1.09	Yes	N/A
P. Shrimp	2	Collected	$0.49	Yes	N/A
P. Shrimp	3	MAC-certified	$0.79	Yes	N/A
P. Shrimp	4	Tank-raised	$0.49	No	N/A
P. Shrimp	5	Collected	$0.79	No	N/A
P. Shrimp	6	MAC-certified	$1.09	No	N/A
O.S. Clownfish	1	Tank-raised	$2.99	Yes	N/A
O.S. Clownfish	2	Collected	$1.75	Yes	N/A
O.S. Clownfish	3	MAC-certified	$2.25	Yes	N/A
O.S. Clownfish	4	Tank-raised	$1.75	No	N/A
O.S. Clownfish	5	Collected	$2.25	No	N/A
O.S. Clownfish	6	MAC-certified	$2.99	No	N/A
S/C Hogfish	1	Collected	$14.50	N/A	Small
S/C Hogfish	2	Collected	$9.00	N/A	Medium
S/C Hogfish	3	Collected	$11.50	N/A	Large
S/C Hogfish	4	MAC-certified	$9.00	N/A	Small
S/C Hogfish	5	MAC-certified	$11.50	N/A	Medium
S/C Hogfish	6	MAC-certified	$14.50	N/A	Large
Q. Angelfish	1	Collected	$45.00	N/A	Small
Q. Angelfish	2	Collected	$15.00	N/A	Medium
Q. Angelfish	3	Collected	$30.00	N/A	Large
Q. Angelfish	4	MAC-certified	$15.00	N/A	Small
Q. Angelfish	5	MAC-certified	$30.00	N/A	Medium
Q. Angelfish	6	MAC-certified	$45.00	N/A	Large

[a] The MAC-certified profiles were also collected from the wild.
[b] N/A indicates that the attribute was not applicable (not defined) for that species.

After specifying the importance of each of the three attributes for a given species, respondents were asked to evaluate each of the six profiles by rating the products on a pre-defined scale. Since respondents are firms, "preferences" were defined as the profitability of purchasing the product for resale. The scale ranged from –5 for a very unprofitable product to +5 for a very profitable product. Zero was defined as representing a breakeven product and, thus, also served to 'anchor' the responses (i.e., control for different anchoring points of each respondent; Mackenzie).

Lastly, respondents were asked to state their (1) purchase interval (i.e., never, bi-weekly, weekly, bi-monthly, monthly, quarterly, semi-annually, or annually) and (2) the total quantity their firm would be willing to purchase at each interval. The product of these two variables (after quantifying the purchase interval) provides the total annual demand of each profile by each firm.

The ratings, purchase interval, and demand information collectively comprise a 'market experiment' for each species. The experiments were presented to the respondents for each species in turn following the background information. Each experiment began with a summary and picture of each species. The summary defined certain characteristics that were expected to be important but excluded from the experiments. For instance, respondents were told that the peppermint shrimp in each profile were the same size (i.e., 2 inches). To control for specific coloring, a picture accompanied each experiment. To control for uncertainty associated with the supplier, respondents were instructed to assume the product was available from one of their existing, most trusted, suppliers. For any other important characteristic that was excluded from the experiment, respondents were instructed to assume a level but that level had to remain constant across all profiles.

The layout of the remainder of the experiment was organized as follows. The importance rating of each attribute was followed by boxes for each of the six products in turn. Within each box, there was a description of the product followed by the relative profitability rating, purchase interval, and total demand.

Host Site Selection

Although stated preference surveys were traditionally conducted by personal interviews or by mail, due to the need to visually compare product profiles, these traditional methods are not efficient for this survey since respondents are located worldwide and color pictures are expensive to include in printed form. Alternatively, the growth of the Internet provides an appealing alternative and many advantages. The advantages of using the Internet to conduct a CA survey include the ability to use color graphics at no additional cost, higher completion rates due to the novelty and shorter time required, and larger geographic coverage due to the lower cost of an Internet site versus repeated mailings or personal interviews (Meyer). Further, higher completion rates on specific questions can be achieved since blank responses can trigger "pop-up" reminder boxes, Some of the difficulties inherent with conducting web-based interviews include attracting respondents to the site, reaching firms without Internet access, and verifying the authenticity of the respondents (Meyer).

There are several considerations and needs to address before selecting supporting services and agencies. The first, and possibly the most important decision, involves the selection of the Internet service provider (ISP) on which to host the survey. Larkin, Tucker, and Degner identified nine criteria to facilitate the selection and how each could be met by Yahoo Web Services (YWS), Inc. In the end, YWS was selected to host the survey. The criteria are discussed, in no particular order, below.

The first criterion was the time necessary to make any changes to the site. An ISP, unlike many educational or organizational sites, considers customer service first and

foremost and also allows a higher degree of access. Therefore, with YWS we were able to have direct and complete control over the site, which means it would be possible for us to make changes and corrections (if necessary) immediately.

The degree of sophistication regarding available software tools was the second criterion. Some of the functions necessary in web-based surveys include web page design and publishing and a mechanism to authenticate, authorize, and collect data from respondents. Often, the authentication dilemma can be solved by identifying the respondents through usernames and passwords. Once the system identifies the individuals they are given the appropriate authorization to view specific pages and submit responses. Perhaps the most important step is the storage of the responses (i.e., data) associated with the authenticated and authorized respondent. The advantage of using YWS (as compared to a non-profit third-party site is that they make it easy to use common software that can manage previously mentioned mechanisms. For example, YWS recently added software that allows use of Microsoft FrontPage 2000. This software greatly facilitates management of authentication, authorization, and data collection mechanisms from the desktop; second party educational and organizational sites (including the University of Florida) typically do not provide this capability.

The third criterion is the level of expertise of the implementers. If, as is the case in this study, the project investigators are relatively inexperienced regarding the use of web software tools, the access to user-friendly software eliminates the need to learn complex software or to confront compatibility issues (i.e., the ability of respondents using different browsers to view the survey or the ability of the project investigators to combine the survey results). Since YWS provides user-friendly software, there is an additional advantage of hiring this service.

The fourth issue is the actual web address that respondents will need to provide in order to reach the survey. One of the difficulties identified as inherent with web-based surveys is attracting respondents to the site. Thus, a simple, concise web address can facilitate and encourage participation. Using subdirectories, which would be necessary with a third party host, could reduce the number of responses.

The fifth criterion is agency involvement, such as the need to identify the survey with the supporting institution in order to increase the survey's credibility. However, it is important to maintain neutrality by distinguishing the survey from advocacy or for-profit organizations. The inclusion of agency icons, banners, or active links within the survey instrument can distract the respondent, potentially causing them to abandon the survey.

Total cost is the sixth issue. YWS was the lowest cost alternative for a host site for this project given the availability of an integrated suite of software that would otherwise need to be purchased. YWS is operated as a subscription whereby a fixed fee of $14.95 is paid each month. There was a one-time set-up fee of $14.95, however, that fixed cost (and the monthly fee) could be prorated across multiple surveys based on the same site.

The seventh criterion pertained to the selection of software to develop the site and collect and store the data. Since data management is critical, the ease with which the information can be stored, merged, and access is important. Again, the suite of software

products offered through YWS (and the ability to dictate different levels of access for different project investigators) satisfies this criterion.

The eighth issue was site administration. The proposed site must allow direct access bythe various individuals involved with the project; YWS allows for multiple-site administrators and varying levels of access for each. This is very important and necessary, especially if several different surveys are located at the same site simultaneously. Third-party hosts can be reluctant or unable to offer such access.

Lastly, the host site must be reliable. Since it is important for the site to be accessible any moment, the site should be hosted with an organization that is committed and capable of ensuring the infrastructure is online 24-7. As YWS's contracts with commercial sites, they have sufficient incentive to provide reliable services. In addition, YWS is a well-known, respected, and trusted service.

Taking all of the criteria into account, YWS was found to be the best and most affordable choice as a host site. The domain name used for the survey was agsurveys.org. The site currently contains a demonstration survey and project results.

MODEL SPECIFICATION

Conjoint

Traditional conjoint models decompose a firms' total utility (profitability rating) for a hypothetical product into combinations of "part-worths" (β) for each product attribute (*X*). Using Ordinary Least Squares (OLS) regression procedures, the following equation can be estimated for each respondent:

$$(1) \qquad \pi_h = \alpha + \sum_{i=1}^{n} \sum_{k=1}^{m} \beta_{ik} X_{ik}^{h}$$

where *n* is the number of attributes, *m* is the number of attribute levels, and α is an intercept that represents the mean profitability rating. This additive specification is known as the "main-effects only" model since each level of each attribute is included in the model using binary (dummy) variables (Akaah and Korgaonkar). This specification is most applicable when all characteristics represent categorical data. When attributes are measured numerically, such as price or fish length, these attributes can be included as a single variable and (if warranted) estimated using a non-linear functional form (e.g., quadratic, logarithmic, or exponential) (Holland and Wessells).

Aggregate market studies, on the other hand, are interested in testing differences between firms. By creating dummy variables for firm characteristics (from the demographic information) it is possible to estimate and test whether preferences (profitability) vary by firm size, location, and market segment (distributor, wholesaler, retailer, etc.) (Holland and Wessells; Sylvia and Larkin). That is, the dummy variables can be used to account for heterogeneity of preferences across respondents (Harrison, Gillespie, and Fields). This is the aggregate conjoint model:

$$(2) \qquad \pi_{hl} = \alpha + \sum_{i=1}^{n} \beta_i X_i^h + \sum_{i=1}^{L} \delta_l D_l + \sum_{i=1}^{n} \sum_{i=1}^{L} \gamma_{il} X_i^h D_l \quad .$$

In this specification, the profitability of each product (h) by each firm (l) is regressed against each product characteristic (X) and each demographic variable (D) and interactive terms (typically only a subset are included). By including interaction variables, it is possible to allow for the estimated attribute value to depend on the level of other attributes or vary by firm demographics.

Aside from including interaction terms into the previous model specification, researchers have also attempted to improve empirical results by using the attribute importance scores to weight the estimated coefficients. This is known as an aggregate hybrid conjoint model:

$$(3) \qquad \pi_{hl} = \alpha + \sum_{i=1}^{n} \beta_i w_i X_i^h + \sum_{i=1}^{L} \delta_l w_i D_l \quad .$$

According to Anderson and Bettencourt, this specification helps minimize the bias from using a large number of attributes and levels and reduces the likelihood that unimportant attributes are overstated in the estimation. In addition, using the attribute importance scores as weights essentially serves as an additional proxy for heterogeneous preferences among buyers. However, the importance scores (w_i) are needed for each attribute level in order to be effective weights. Given the use of multiple experiments in this study, collecting this information may be prohibitive in terms of response time.

These conjoint and hybrid conjoint models can be estimated using OLS techniques provided the incidence of bound values is negligible. If the percentage of bound values is high, the estimates could be "corrected" using the inverse of the proportion of non-bound values or estimated using a procedure that can account for the restricted variable range of the dependent variable (e.g., Tobit analysis) (Greene). Since each firm evaluated multiple products, the estimation procedure should account for firm-specific variances (cross-section heteroskedasticity). Estimating these models, regardless of the technique used, provided for statistical testing of the estimated coefficients in each model. In particular, tests determined the probability that $\beta_I = 0$ and $\delta_l = 0$, and compared the explanatory power of each model (i.e., adjusted-R^2 values). Testing to determine if the coefficients are significantly different from zero indicates whether the attribute (or attribute levels, depending on how the characteristics are defined) influences the profitability rating. It should be noted that recent studies show that the statistical significance and sign of estimated coefficients appear to be robust to the estimation method, however, OLS results are theoretically biased and tobit tend to be better than probit (Boyle et al.; Harrison, Gillespie, and Fields).

Breakeven Prices and Demand

The empirical aggregate conjoint models can be used to derive the breakeven prices for various products and firm types (i.e., size, location, market position). This is accomplished by setting the left-hand-side of the equation (i.e., the relative profitability) equal to the breakeven profitability (i.e., zero) and assuming levels for all right-hand-side variables except for price, then solving for price (which equals the price that would allow the firm, as defined, to breakeven). The desire to calculate breakeven prices requires that the profitability (conjoint) equations be estimated with a least squares procedure. The value of being able to determine breakeven prices is that premiums and discounts can be determined and used for production, marketing, and promotion decisions. In addition, the premiums can be compared to costs.

The profitability ratings (dependent variable) can be replaced by the quantity demanded (Q_{hl}) in the previous equations to estimate short-run firm level demands. Similar estimation issues need to be addressed in this model (e.g., incidence of bound values and heteroskedasticity). The parameter estimates in these models indicate the change in number of individual specimens demanded in an average (typical) year and they are tested as in the profitability model.

Even though demand equations provide very useful information, using experimental data to estimate market effects can be misleading in the sense that they do not incorporate choice behavior or probabilities associated with market behavior. However, it is possible to consider this additional information in this study by using the stated profitability scores and market demands. For example, each firms' profitability scores can be used to assign relative rankings to each product. This is because the Internet survey form will not allow blanks (i.e., unanswered questions). Alternatively, it is assumed that if a firm specified a demand for a product, then it reflects a purchase choice. Letting the purchase decision be represented by a binary zero-one variable (Y_h=1 if product would be purchased, 0) otherwise) a logistic specification can be used to estimate the probability that a firm will purchase a given product. In particular, Y_h represents a firm's implied choice for product h (Y_h=1) when Q_h >0 (or, alternatively, when π_h >= 0). Conversely, the product is not purchased (Y_h=0) when Q_h <= 0. Letting the right-hand-side of the conjoint equations be represented by Z_h, the following probabilistic statement results from assuming a logistic cumulative distribution function, F:

$$(4) \qquad P_h = P_h(Y_h = 1) = P_h(Q_h \geq 0) = F(Z_h) = \frac{e^{Z_h}}{1 + e^{Z_h}}$$

where P_h is the probability of purchase. The corresponding independent likelihood function is as follows:

$$(5) \qquad L(Y_h | Z_h) = \prod_{\forall} \left(\frac{e^{Z_h}}{1 + e^{Z_h}} \right)^{y_h} \left(\frac{1}{1 + e^{Z_h}} \right)^{(1 - Y_h)} .$$

An estimable equation is derived by taking the natural logarithm of the ratio of the probability of purchase to the probability of not purchasing. The resulting equation specifies that the continuous (log) odds ratio is linearly determined by product and respondent characteristics, Z_h:

$$(6) \qquad \ln\left|\frac{P_h}{1-P_h}\right| = Z_h \quad .$$

Estimation of this equation also allows for statistical tests on the individual coefficient estimates as in the conjoint equations since:

$$(7) \qquad Z_h = \alpha + \sum_{i=1}^{n} \beta_i X_i^h + \sum_{i=1}^{L} \delta_l D_l \quad .$$

The coefficients in this equation are interpreted as "probability impacts" and can be used with the estimated demands to construct expected short-run, firm-level demands as described in Objective (4). This is possible since product price is a continuous explanatory variable in the model.

Expected short-run demand for a given product is calculated using the estimated demand and logistic equations. Demand curves are derived by multiplying the quantity demanded of a given product) by its corresponding probability of purchase at each price. These curves measure potential firm-level short-run demand as a function of improvements in product attributes (Sylvia and Larkin).

RESULTS

A description of the results begins with a discussion of the response rate and the length of time it took each respondent to complete the survey (and each "page" of the survey). These background statistics are followed by a description of the survey respondents. Then the profitability scores and stated demands are regressed against the attribute levels (which are typically defined as binary variables) and demographic characteristics of the firm and respondents that allow for statistical significance tests. The breakeven prices are obtained by setting the profitability level equal to zero and assuming levels for all other variables except for price; by solving for price we obtain the "breakeven" price, that is, the highest price a firm could pay and allow the firm to earn normal economic profits (i.e., given their knowledge of what price they will be able to sell the product for). By changing the value of select variables, different breakeven prices can be obtain and their differences provide a measure of price premiums/discounts that would reflect the underlying change in cost. The demand equations provide estimates of how each variable affects the annual demand of that species.

Response Rate and Completion Times

The response rate can only be approximated given that invitations to participate in the survey were sent to all members of industry organizations/associations that cover marine species. Since these groups are not exclusive to marine species, the survey was not relevant to all members. In the invitation, respondents were asked to reply by email or a toll-free telephone number if they only handled freshwater species. We used those replies to correct the estimate of the total sample size. However, if any freshwater-only recipient of the invitation did not reply that the survey was not applicable to his/her firm, then the response rate will be conservative.

Member lists from three organizations were used as potential respondents, namely: Ornamental Fish International (OFI), American Marinelife Dealers Association (AMDA), and the *West Coast Ornamental Wholesalers* directory. The first organization is comprised of both marine and freshwater industry members and those respective firms were not distinguishable. The latter directory contained both marine and freshwater firms but the product lines of each were identified. Thus, the OFI list was the only one that contained firms that may not handle marine species. Since the OFI membership list contained what appeared to be partial mailing address (and to keep costs low), all OFI members outside the U.S. and Canada were only contacted by email. In total, three protocols were developed to invite firms to participate in the study. The first was for the OFI firms and those for which only had email addresses. The second was for firms that only had a postal address. The third was for firms that had both a postal and email address. These protocols were developed so that postal invitations and follow-up reminders could be sent by postal address (if available) since a 'hard copy' letter with official University letterhead was thought to add credibility to the project.

Of the total 329 initial invitations, 34 (10%) were returned as undeliverable (i.e., moved without a forwarding address, incorrect address, or invalid email account). Of the remaining 295 invitations, 126 (43%) went to OFI members that may or may not even handle marine species. Overall, 54 firms logged into the site, completed the first page, and looked at the introductory market experiment page. Thus, a conservative estimate of the response rate is 18% although it may be as high as 32%.

As a final caveat (aside from some site details described below) one of the follow-up reminders inadvertently suggested that only those firms handling marine species should respond. This wording caused one firm to reply with "since I carry both salt AND freshwater, that leaves me out of this"; despite a follow-up note to clarify, this firm never completed the survey. Hence, this error could have lowered the response rate.

From 30 to 35 respondents completed the market experiments. Response rates were highest for peppermint shrimp and lowest for orange skunk clownfish, likely because those were the first and last experiments, respectively. All those who completed fewer experiments were among those that completed all experiments; thus, the description of survey respondents will focus on the 35 that completed all experiments. Given the use of restrictions on individual fields, all responses are usable since all questions were answered.

To complete the entire survey, respondents needed to access a series of pages. The initial page contained a welcome to the survey site with a link to the "Marine Ornamentals" survey page, which included a brief statement and link to "login." Following a successful login using the unique username and password that had been sent via electronic or postal mail, respondents were sent to the "Background" page containing questions about the firm and respondent (i.e., product line, number of marine species, number of tank raised species, location, years in business, familiarity with MAC, etc.). The first date/time stamp was recorded (with the numerically coded responses to each question and the username) when respondents selected the "Proceed to Market Experiments" button. The initial market experiments page described that respondents would be evaluating each of the four species in turn and directed them to "Proceed to Shrimp". By selecting that button, respondents were directed to the market experiment page for peppermint shrimp, which required an evaluation of each attribute then specifying the relative profitability, purchase interval, and purchase quantity for each of the six product profiles. With the exception of the purchase quantity, all responses were in the form of selecting a button or through pull-down menus. At the bottom of the page was a button to "Proceed to Angelfish"; once selected the data on peppermint shrimp were submitted to a separate file. This same procedure was used for the three remaining species as well. Following the last market experiment, respondents were to select a button to "Proceed to Follow-up", which asked a series of open-ended questions. Data from this page were saved to a file when the respondents selected the button labeled "Finish Survey". The final page thanked the responded and provided contact information.

The date/time stamp data from each page was used to calculate the length of time required to complete the survey, with exception of the first page; by not collecting the date/time stamp at login, this information was not collected. Thus, comparative data from those individuals only completing the first page are not available. Of those who completed multiple pages of the survey, average response time was 26 minutes (again, exclusive of the initial login time and completion of the first page with the background questions) (Table 3). Length of time to complete the experiments and answer the open-ended follow-up questions ranged from 8 to 55 minutes. The shorter length of time was recorded from individuals that returned to complete the survey later and, thus, did not need to re-read the questions. The average length of time needed to complete each experiment (i.e., evaluate each attribute and compare and evaluate each of the 6 product profiles), ranged from 3 to 9 minutes; the latter for the first experiment (peppermint shrimp) and the former for the last two experiments (orange skunk clownfish and spotfin hogfish). However, times to complete each experiment ranged from 1 to 26. The narrow standard deviations suggest a relatively high degree of uniformity regarding time requirements. Times to complete the follow-up page ranged from zero to 21, some individuals provided excellent suggestions regarding the site and, primarily, additional species that could be used for the experiments.

Some observations regarding the Internet aspect of the survey are in order. We received 6 responses, all from foreign firms, stating that they were unable to login. Upon verification of their usernames and passwords, a follow-up note was sent asking them to try again. The ensuing dialog made it clear that these individuals were inexperienced at

using the Internet and were attempting to search for the site versus entering it directly into the address line. Despite our attempts to describe the procedure, these firms did not complete the survey.

Table 3. Response Rates and Average Times by Survey "Page"

		Time to Complete (minutes)			
Survey Page	N	Average	Std. Dev.	Minimum	Maximum
P. Shrimp	35	9	4	2	26
Q. Angelfish	33	5	3	2	18
S. Hogfish	31	3	1	1	11
O.S. Clownfish	11	3	1	2	5
Follow-up	32	8	3	0	21
Total (excl. Background)	32	26	8	8	55

Notes: Times exclude duplicate entries. The orange skunk clownfish time stamp malfunctioned early on resulting in the loss of information for that page. A time stamp was not collected after login, thus, no information is available for the initial background page or total completion time. Times were not available for the two respondents who completed hard copies of the survey.

Regarding the collection of usage statistics, we did not collect data on the "hits" (number of unique email addresses) that viewed the initial page but did not login. As mentioned previously, we did not structure the site to save the date/time stamp upon login (which would allow us to determine the time spent answering the background questions). Likewise, we did not collect the number of hits on any of the pop-up pages that contained additional explanatory information. Given that this information could have been saved (and the time required to prepare and link to the pop-up sites), this was an oversight. In addition, we have no information on individuals that came to the site, went to the welcome page for the marine ornamental survey, logged into the site and began to enter (but did not complete) the first page of the survey that contained the background information. Since throughout the site we required valid responses (e.g., numbers, text, or the selection from a menu), we have no information on the proportion of respondents who might have been deterred from completing the survey. This was perhaps the most damaging oversight since, if requiring responses was significantly preventing completion of the survey, some of these requirements could have been changed to increase responses. An alternative would be to have more "pages" that contained increasingly sensitive information; the advantage would be (perhaps) a higher response rate on some questions at the cost of having additional results pages (which increases the complexity of the analysis). Also, the site was designed in a linear fashion (where respondents moved from page one to page two, etc.) in order to get a total response time; alternatively, allowing respondents to move throughout the experiments might also have increased the response rate. Lastly, it is possible to collect response time data on each question by putting each on a separate page; while this would likely not detract the respondent, it significantly increases the amount of programming needed to design the site.

Respondents

Of the 35 responding firms, 80% were located in the U.S. and 77% use the "tank-raised" source as a marketing tool. No firm that responded to the survey reported sales of marine fish in 2000 that exceeded $10 million; the majority of respondents reported sales below $100,000 (Figure 1). In terms of market segment, the majority of firms selected "retailer" as their primary function (Figure 2). Variables reflecting the responsibilities and knowledge level of the respondent indicated that 54% held a managerial position within the firm and 91% knew the source of their inventory. Respondents averaged 15 years of experience although individual responses were uniformly distributed between 2 years and 33 years.

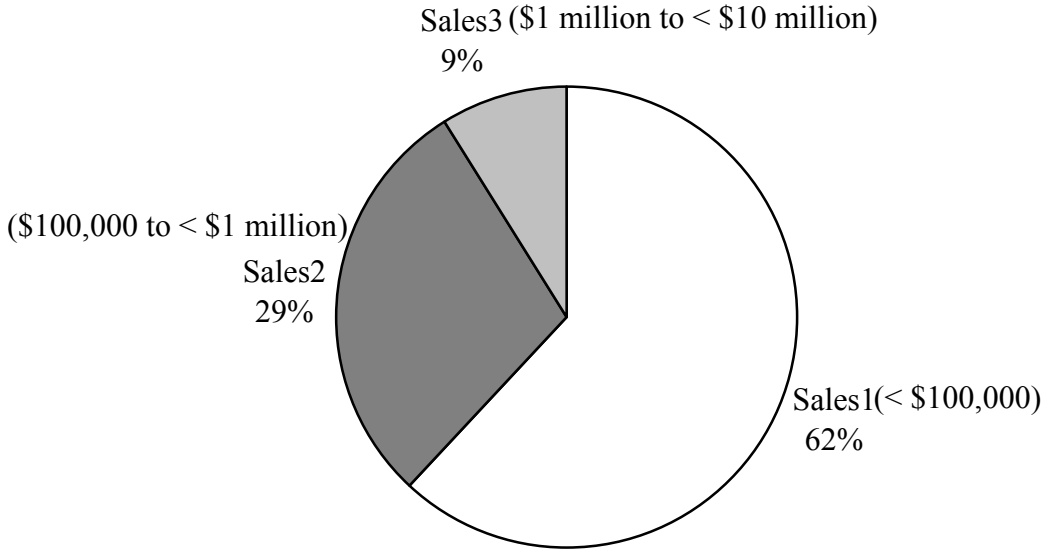

Figure 1. Firm Size based on Total Sales of Marine Fish in 2000 by Respondents

In order to identify the impact that each firm has on the marine ornamentals market, respondents were questioned about the extent of their product lines: non-marine products, freshwater species, marine species, etc. Approximately one-third (29%) of the firms sell non-aquatic products and three-fourths (74%) of the firm sell dry aquarium goods. Also, 60% of the firms provide tank services for hire. Only 17% of the firms collect their own marine fish. Just over half (51%) of the firms sell collected freshwater fish, while 63% of the firms sell tank-raised freshwater fish. Additionally almost all of the firms (91%) of the firms sell collected marine fish, and 86% of the firms sell tank-raised marine fish. The average number of marine species handled by the firms over the course of a year is 171 (this number ranges from 12 to 600). On average, 18 of those were tank-raised; although the number of marine tank-raised species handled ranged from zero to 120. Respondents also responded to questions regarding their purchasing patterns. The

majority of the firms (54%) always purchase from the same suppliers and 60% receive price discounts for large volume orders.

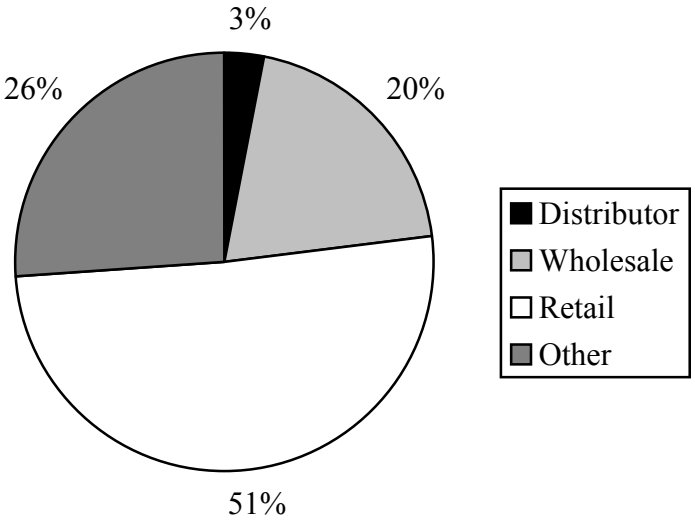

Figure 2. Market Segmentation based on "Primary Function" of Respondents

Of the 10 defined geographic regions, the majority of the responding firms (60%) have collecting, holding, and/or shipping facilities on the U.S. mainland. An additional 14% have facilities in Hawaii. Sixty-two percent of the firms have facilities outside the U.S. (primarily Indonesia). These could be the same firms since respondents were allowed to select all that applied.

Regarding the MAC-certification program, respondents were asked how familiar they were with the program and then how likely they were to participate in the program. The majority of respondents said they were familiar with the program and likely to carry and/or become certified (Figure 3).

Although between 30 and 35 firms completed the market experiments, a total of 54 firms responded to the survey (i.e., completed the first page on background information). Thus, 65% completed at least one market experiment. Given the relatively high percentage that did not progress pass the first page, it is helpful to compare the characteristics of those that completed a market experiments and those that chose not to continue. A smaller proportion of the non-completers were located in the U.S. (73% versus 80%) and a larger share was in the smallest size category in terms of sales of marine fish in 2000 (69% versus 62%). The really large firms in the sample (i.e., those with sales of marine fish in excess of $25 million in 2000) were among those that did not complete any of the market experiments. This latter group also had a larger portion that did not know the source of their inventory (21% versus 9%) and a much smaller portion use "tank-raised" as a marketing tool (42% versus 77%); hence, the very large firms appear to rely more on volume sales and less on supplying information about their

products. The large firms, therefore, would likely be less interested in the MAC-certification program.

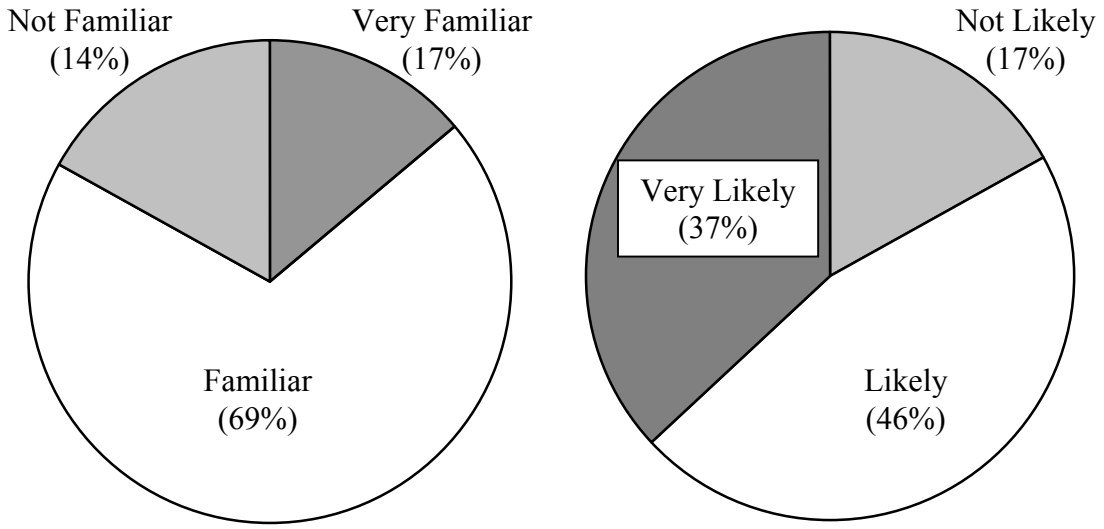

Figure 3. The Familiarity With and Likelihood of Using the Proposed MAC-Certification

Regarding the distribution among market segments of respondents versus those firms that did not complete the market experiments (i.e., 19 of 54 or 35%), the latter category contained a larger share of trans-shippers/distributors (11% versus 3%) and wholesalers (32% versus 20%) and a smaller share of retailers (37% versus 51%). Lastly, those that did not proceed in completing the market experiments were less familiar with (42% versus 69%) and less likely or very likely (57% versus 83%) to participate in the MAC-certification program. Overall, the respondents of the market experiments were perhaps more interested in the survey due to it's focus on the MAC-certification program and what it represents.

Preferences

Variable Definitions and Hypotheses

There were six product attributes that were used in developing the product profiles (Table 2): whether it was MAC-certified, price, size (small, medium, or large), whether it was tank-raised, and whether survival was guaranteed upon arrival. All but price are expected to positively impact the profitability rating given that each is a binary 0-1 variable whereby the variable takes on a value equal to one for a product (i.e., marine fish or invertebrate) that is MAC-certified, larger, tank-raised and whose survival is guaranteed. In other words, a marine specimen with these attributes would be more profitable with the same price. Assuming that marine ornamentals are “normal” goods, then profitability should fall if price increases (hence the hypothesized negative sign). Note that these

hypotheses hold only for the profitability model (i.e., there is no *a priori* information on the relative demand for larger specimens). Table 4 contains a summary of all variables used in all models. Note that a maximum of 19 are available for use in any given model.

Table 4. Variable Definitions and Hypotheses for Profitability Model

Variable	Ho	Description
Intercept	+/-	Represents value of all base categories
Product Attributes:		
MAC	+	Product is MAC-certified
Price	-	Product price
Medium	+	Fish is "medium size"
Large	+	Fish is "large size"
Tank	+	Specimen is tank-raised (i.e., aquacultured)
Guarantee	+	Specimen's survival is guaranteed
Firm Sales in 2000:		
Sales1	N/A	Gross sales marine fish < $100,000 (base category)
Sales2	-	$100,000 ≤ gross sales marine fish < $1 million
Sales3	-	$1 million ≤ gross sales marine fish < $10 million
Primary Function of Firm:		
Trans-shipper/Distributor	N/A	Firm primarily moves product (base category)
Wholesale	+	Firm is primarily a wholesaler
Retail	+	Firm is primarily a retailer
Other	+	Firm is primarily none of the above, perhaps service
Other Firm Characteristics:		
Domestic	+/-	Firm is located in the U.S.
Promote	+	Firm uses "tank-raised" as a marketing tool
Handle	+/-	Firm has purchased the species in the past year
Respondent Characteristics:		
Manager	-	Respondent is manager and more sensitive to price
DKnow	+/-	Does not know source (tank-raised or collected)
Knowledge of MAC:		
NF_MAC	N/A	Firm is not familiar with MAC cert. (base category)
F_MAC	+/-	Firm is familiar with MAC certification
VF_MAC	+/-	Firm is very familiar with MAC certification
NL_MAC	N/A	Firm is not at all likely to adopt MAC (base category)
L_MAC	+	Firm is likely to adopt the MAC certification
VL_MAC	+	Firm is very likely to adopt the MAC certification

Notes: Price is the only continuous variable. For a description of the levels of each product attribute, see Table 1. The hypotheses (Ho) are relative to the base category, which is embedded in the intercept term. The hypothesis will likely differ for the demand models. With the exception of the intercept and price parameters, all variables are defined as binary variable using the 0-1 convention (i.e., the variable equals 1 if it is present and 0 otherwise). For example, MAC = 1 if the product is MAC certified.

Several variables were defined to account for heterogeneous preference of firms with different characteristics. Three dummy (i.e., binary 0-1) variables were used to distinguish the medium (sales2) and large firms (sales3), based on their total sales of marine fish in 2000, from the smaller firms. Recall that the distribution of respondents by firm size was presented in Figure 1 and the majority of firms fall with the base-level small category. In other words, the coefficients on the sales2 and sales3 variables represent the difference in profitability ratings for the medium and large firms, respectively, as compared to the small firms (sales1). These variables are expected to be negative indicating that *ceteris paribus* (holding all other variables constant) larger firms would perceive the product as less profitable (e.g., if larger firms could obtain price discounts).

Four binary dummy variables were defined to account for the primary function of each firm. The base category (i.e., the category that is not estimated and to which all other coefficients are compared) includes the trans-shippers and/or distributors because that contains the fewest observations and is believed to be the closest to the collectors. If so, we would expect the coefficients on the other market segments (i.e., wholesale, retail, and 'other') to be positive. Note that firms selecting 'other' as their primary function could represent firms that specialize in offering tank set-up and maintenance services, which are becoming increasingly popular (Larkin et al., 2001a). The distribution of respondents by primary function or market segment was presented in Figure 2. The majority of respondents are retailers.

Other characteristics of firms that were accounted for in this study included whether the firm was located in the U.S. (domestic); whether the firm uses "tank-raised" as a management tool (promote) and, thereby, may view attempts to certify ecofriendly harvesting practices more favorably; and whether the firm purchased each species used in the market experiments in the preceding year (handle). The hypotheses regarding each of these variables is facilitated by recalling that all other characteristics are held constant, including price. For 'domestic', the expected sign cannot be determined since (although prices were defined in U.S. dollars), the location of their market is unknown. Do domestic (U.S.) firms view the product as more or less profitable? The sign of the estimated coefficient will (if statistically significant) indicate the difference in average profitability ratings, which reflects (in part) the level of the exchange rate at the time of the survey. For firms that promote cultured products, we expect those firms to view the products more profitable given they use a form of ecolabeling (i.e., a positive sign is expected). If a firm has handled the product in the last year we expect their average profitability rating to differ from firms that are inexperienced with the species; however, the sign of this effect is unknown *a priori* (before estimation).

In addition to characteristics of the firm, questions were also included to account for the characteristics of the individual who completed the survey. The two characteristics included in this study are whether the individual has any managerial responsibilities and whether he/she knows the source of their inventory (i.e., whether the specimens were collected from the wild or aquacultured). We hypothesize the individuals with managerial duties are more sensitive to prices and, thus, will view products in the

market experiments less profitable at the same price. If an individual does not know the source of their inventory, indicating they are less knowledgeable regarding their product line and have less information to offer customers regarding the specimens, we expect their preferences (and, thus, average profitability level) to differ although the sign of this effect is unknown *a priori*.

Respondents were also asked about their familiarity with the proposed MAC certification program (i.e., they could select one of three possibilities: not at all familiar, somewhat or moderately familiar, very familiar). Each response was translated into a binary 0-1 variable in order to estimate and test for differences in average profitability ratings by degree of familiarity, which would facilitate interpretation of the results. Likewise, the responses to an inquiry regarding how likely the firm is to adopt or participate in the certification in the coming year (not at all likely, somewhat likely, very likely) were also defined as unique binary 0-1 variables for empirical modeling. The distribution of responses to these questions was shown in Figure 3. Overall, there is a fairly uniform distribution of responses (i.e., the sample includes individuals from every category). The expected sign of the familiarity variable is unknown *a priori* since the costs of the program are unknown (*MAC Newsletter*). That is, if a firm is very familiar with the program he/she knows that the fee structure for participation has not be determined although he/she knows it will involve an annual payment to the MAC organization and the need to hire an independent third-party certifier (which involves an initial fee and recurring monitoring inspections). Whether this information results in a higher or lower average profitability rating will depend on how high he/she expects these fees to be. Conversely, if a firm is likely to adopt the program they have already assessed its profitability such that their expected average profitability rating would be higher (i.e., a positive sign on the likelihood variables is anticipated).

Attribute Importance

Each market experiment began with an assessment of the importance of each attribute to their purchasing decision. Importance was to be ranked on a scale of 1 (not important) to 5 (very important). As shown in Table 5, the average importance scores for the attributes varied by species.

Table 5. Average Attribute Importance and Rank (1=most important) by Species

Attribute	Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
Source	3.87 (1)	3.67 (1t)	4.43 (1)	3.51 (3)
Size	3.58 (2)	3.67 (1t)	N/A	N/A
Survival Guarantee	N/A	N/A	4.33 (2)	4.26 (1)
Low Price	3.48 (3)	3.60 (3)	3.40 (3)	3.54 (2)

Notes: Attributes correspond to those used to construct the profiles in Table 2. Importance ranged from 1 (not at all) to 5 (very). Importance ranks are in parentheses; "t" indicates a tie.

Overall, the attributes were most important for the orange skunk clownfish where two attributes had average importance scores exceed 4.3. The most important attribute for the fish species was the source (collected, collected and MAC-certified, or tank-raised), then the size (angelfish and hogfish) or survival guarantee (clownfish). The survival guarantee was the most important for the peppermint shrimp, which could indicate a relatively high mortality rate for this species. Source was least important for the only invertebrate in the group (shrimp); conversely, price was the least important for the fish species. The lack of importance of price suggests a potential for attribute-related market effects, including MAC-certification.

Estimation Methods and Fit of Models

The first analysis conducted was estimation of the profitability model for each species. Two estimation procedures were employed and compared, namely ordinary least squares (OLS) and tobit analysis. Both procedures provide estimates of part-worth values, although if the ratings scales are bounded (i.e., if respondents selected either -5 or +5) then the OLS estimates will be asymptotically biased since the residuals will be truncated (Harrison, Gillespie, and Fields). The two-limit tobit, on the other hand, can avoid the biased parameter problem associated with OLS and the ordinal and cardinal information contained in the ratings will be retained (Mackenzie; Harrison, Ozayan, and Meyers). Thus, if respondents are asked to rate products on a pre-defined scale and use the bound values of the scale, it is possible that their evaluation was truncated (e.g., they would have wanted to assign higher or lower numbers) and tobit analysis is the most appropriate. However, if the scale is defined to be relative and inclusive then, by definition, the use of a bound value does not suggest truncation but instead that the profile is the most or least preferred compared to the rest. To our knowledge, no studies have addressed the most appropriate estimation method for this scenario. Studies that have compared OLS and tobit results conclude that efficiency is generally (but not always) improved with the tobit approach (Harrison, Gillespie, and Fields and papers cited therein). Recall that OLS is theoretically inefficient if results are truncated, but do they remain inefficient if the ratings are not truncated? To address this issue, models are estimated using both OLS and tobit.

It should be mentioned that two other approaches could have been used on this data set, namely the ordered logit or probit. Both approaches take into consideration that the dependent variable is discrete (i.e., the ratings were in whole numbers only). Clearly, if the observed dependent variable had been rounded, then a probability-based analysis would be appropriate. However, when respondents are directed to assign rankings based on relative comparison and a pre-defined scale (especially one that includes a breakeven point and negative values), the same justification does not automatically hold. This is because responses are not being rounded; for example, if a respondent had already assigned rankings of 2 and 3 and wanted to then assign a value in between, they would adjust their previous rankings until all the ratings reflected both their cardinal and ordinal preferences. The implication is that OLS or tobit would be the appropriate estimation method. Recent studies have found that model selection may make little difference in

regards to the consistency of parameters estimates (sign and statistical significance), however, the tobit model may be superior theoretically and in predicting ordinal rankings (Boyle et al; Harrison, Gillespie, and Fields). That said, the primary criteria in selecting a model specification and correspondent estimation method is the intended use of the data. Given that one of the objectives of this study was to calculate breakeven prices, the profitability equations need to be estimated using a method that estimates the part-worths directly (i.e., OLS or tobit). Recall that the part-worths represent the change in the profitability rating of the average respondent.

The explanatory power of OLS profitability models, as measured by the R-squared value, ranged from 46% to 59% and produced between 58% and 78% (11 to 14) statistically significant variables. The R-squared values indicate a good fit for aggregate conjoint models. Recall that each model (one for each species) had, at most, 19 parameters to estimate. The queen angelfish data set did not include any "other" firms such that only 18 parameters were estimated. The number of observations also varied for each experiment since not all respondents evaluated all four species (i.e., completed all of the market experiments). Since the number of respondents ranged from 30 to 35, the number of observations ranged from 180 to 210 as each experiment consisted of evaluating 6 product profiles. By estimating the same model using the tobit approach, the share of observations with bound ratings (i.e., percentage right and left censored at 5 and -5, respectively) are taken into consideration. The share of censored values ranged from 14% to 24% such that the tobit estimation method is expected to produce different results. Note, however, that if the share of censored observations is relatively small (e.g., less than 10%), then OLS results can be made to approximate tobit results by adjusting the estimated coefficients by the share (Greene). Thus, the tobit approach is expected to only change the size of the coefficient and increase the number of significant variables; it should not change the sign of the variables or reduce the fit.

The log likelihood values for the tobit models ranged from -350.7 to -413.5. The best fit (i.e., LnL = -350.7) corresponded to the spotfin hogfish. The share of estimated coefficients that were statistically significant using tobit estimation ranged from 53% to 83%; thus, contrary to previous findings, the tobit models did not improve efficiency in all models in this study. The number of statistically significant parameters did not change in 2 of the 4 models and actually fell (from 12 to 10 or 63% to 53%) in one (i.e., orange skunk clownfish). Although the signs of the parameters that were statistically significant in both models (i.e., OLS and tobit) remained the same across species, the parameters that were statistically significant changed between models. This change was most noticeable for the spotfin hogfish where only 10 of the 14 significant parameters remained the same. Hence, all but four parameters were statistically significant in at least one of the models (i.e., OLS versus tobit for the spotfin hogfish). Overall, all parameters were statistically significant for at least one of the species using either the OLS or tobit approach. Even though the selection of the appropriate estimation approach is ambiguous for this study, we adopt the tobit model for further analysis of the profitability ratings given the recent arguments suggesting its superiority over OLS that were discussed earlier.

Before comparing and discussing parameter estimates, there is one additional issue that needs to be addressed, namely, whether the data for all firms should be used in

aggregate. An aggregate analysis estimates part-worths that reflect the preferences of the average firm and, thus, should be used when the preferences of the entire market are desired. Using this approach, additional variables can be added to account for differing preference levels between different groups of firms. For example, as defined in Table 4, the primary function of each firm reflects different segments of the market (i.e., distributor, wholesaler, retailer, and other). The aggregate models assume that the average profitability rating varies by each group, but the part-worths of the remaining variables are constant. Thus, the part-worths represent the average across all market segments. As an alternative, different models could be specified for each market segment. Using different models would produce part-worth estimates that are unique to each segment. Such models could provide information specific to each market segment that would be helpful in targeted advertising campaigns.

In this study, we disaggregated the data into retail and intermediate firms, the latter group included the trans-shippers/distributors, wholesalers, and 'other'. The retailers were separated since their place in the marketing chain is unambiguous and there was a sufficient number of observations (Fig. 2). The initial goal was to test whether the estimated parameters as a group differed between models. This is accomplished by using the log likelihood values (LnL) from the aggregate and disaggregated models in a Likelihood Ratio (LR) test. The disaggregated models produced much lower LnL values but these are added and compared to the aggregate LnL under the LR test. This test Chi-squared statistic ranged from 23.8 to 49.4 across species. The corresponding critical values ranged upwards of 30.14 at the 10% level depending on the model. The number of parameters was not the same across models since some variables had constant values within the disaggregated groups (most notably the function or market segment variables used to define each group). Comparison of the test statistic with the critical values indicates that the hypotheses of equal parameter values could not be rejected in at least one model (namely, queen angelfish). Even though the results indicate that the parameter values are statistically significantly different between the intermediate and retail market segments for at least one of the models, we proceed with analyzing and comparing the aggregate results. This decision was made for the following reasons: (1) the test statistics did not strongly support the separation for all species, (2) only the preference from the entire market as an average is desired since, when considering a new product, it must appeal to the market as a whole (e.g., all stages of the market must become MAC-certified), and (3) the analysis of the aggregate results across models is sufficient for an initial analysis and will also provide a basis upon which to conduct more specific analysis in the future if warranted.

The characteristics of each estimated model (16 in total) are summarized in Appendix A, Table A-1. Appendix A also contains all of the estimated models by species (Tables A-2 through A-5). Following the interpretation and comparison of coefficients across models, similar comparisons can be made with the disaggregated models in Tables 2, 3, 4, and 5 for queen angelfish, spotfin hogfish, orange skunk clownfish, and peppermint shrimp, respectively.

Comparisons between Species

Five variables in total (3 product attributes and 2 firm attributes) were statistically significant, and had the same sign, in all the models. The product attributes included price, large-sized fish (which was in the angelfish and hogfish models only), and survival guarantee (which was in the clownfish and peppermint shrimp models only). In addition, the signs were as hypothesized in Table 4. The firm attributes included sales3, the largest firms in terms of sales of marine fish, and wholesale firms. As hypothesized, the average profitability rating of the largest firms was lower; however, contrary to the hypothesis, the average profitability rating of wholesalers was lower than that of trans-shippers or distributors. Thus, trans-shippers and distributors may not represent the initial stage in the market chain as assumed. The empirical results are summarized in Table 6 and the statistically significant individual parameter estimates are discussed below.

MAC certification was statistically significant only for the relatively high-valued species examined in the study, namely, queen angelfish and spotfin hogfish. MAC certification increased the average profitability rating of the angelfish and hogfish by 0.56 and 0.50, respectively. For comparison, these part-worth estimates were the smallest in absolute size of all the coefficients associated with binary variables (i.e., all except for price). In addition, three of the four variables indicating the familiarity and likelihood of adopting the MAC certification program were also significant in the angelfish and hogfish models. These variables were also negative indicating the average profitability is lower for those that are more familiar and more likely to adopt MAC. The negative signs on familiarity could reflect the concerns over the as yet unspecified costs of the program. The negative signs on the likelihood of participating in the MAC certification program differs from the hypotheses; those respondents who were somewhat likely to adopt MAC certification assigned lower profitability scores on average, *ceteris paribus*. Perhaps those who are more likely to participate in MAC certification expect the program to reduce profitability in the short-run. At this initial stage of evaluation, the respondent may only be considering the need to cover immediate costs and not the potential longer-run benefits. At this time, there is no public awareness of the program to generate increased demand and higher prices. Also, the firm may have a preference for supporting sustainable harvests and reducing mortality rates that may not be accounted for in their market. Conversely, the familiarity increased the average ratings of the lower-valued clownfish and peppermint ship. The average profitability rating of shrimp also increased for those who were very likely to adopt the MAC certification program. This effect, which is contrary to those for the higher-valued species, could reflect the potential for obtaining this product from culture facilities; that is, since MAC certification represents an improved sustainability of the stock, which is similar to products that are tank-raised, this variable could be accounting for the tank-raised attribute that was not statistically significant.

Table 6. Tobit Profitability Regression Results by Species (Wald Chi-Sq in parentheses)

Variable	Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
Intercept	7.18***	8.69***	3.65*	4.62***
	(42.2)	(22.1)	(2.76)	(9.13)
Product Attributes:				
MAC	0.56*	0.50*	0.35	0.26
	(3.46)	(3.72)	(0.51)	(0.32)
Price	-0.09***	-0.28***	-0.61*	-3.10***
	(39.5)	(18.3)	(2.35)	(18.9)
Medium	1.00***	0.33	N/A	N/A
	(6.70)	(1.06)		
Large	1.22***	0.86***	N/A	N/A
	(10.7)	(7.09)		
Tank	N/A	N/A	1.17**	-0.04
			(6.42)	(0.01)
Guarantee	N/A	N/A	1.91***	2.55***
			(28.9)	(61.8)
Firm & Respondent Attributes:				
Sales2	-0.33	-0.51	-0.41	1.00**
	(0.64)	(1.62)	(0.43)	(5.61)
Sales3	-2.73**	-2.10**	-4.83***	-2.52***
	(4.94)	(5.06)	(16.0)	(9.18)
Wholesale	-0.94*	-2.79**	-2.94**	-3.04**
	(2.39)	(3.96)	(2.91)	(6.25)
Retail	1.38**	-1.26	-1.86	-2.70**
	(5.89)	(0.86)	(1.39)	(5.08)
Other	N/A	-2.24*	-1.13	-2.52**
		(2.52)	(0.48)	(4.62)
Domestic	0.45	0.78*	0.32	-0.27
	(1.03)	(2.69)	(0.32)	(0.28)
Promote	2.02***	0.88*	1.34*	0.35
	(10.3)	(2.65)	(3.59)	(0.35)
Handle	-1.93***	-0.14	0.41	0.92*
	(11.3)	(0.10)	(0.42)	(2.41)
Manager	-1.87***	-1.30***	-0.43	-0.19
	(26.4)	(10.7)	(0.77)	(0.26)
DKnow	-4.11***	-1.18*	-2.55***	0.76
	(27.1)	(3.69)	(7.59)	(1.35)
F_MAC	-2.60***	-1.36***	0.91*	0.36
	(15.4)	(5.94)	(2.08)	(0.42)
VF_MAC	-2.87***	-1.39***	0.98	1.07*
	(17.8)	(5.94)	(2.06)	(2.72)
L_MAC	-1.70***	-1.76*	-0.18	0.68
	(9.05)	(9.05)	(0.09)	(1.73)
VL_MAC	0.09	-0.20	-1.20*	1.19**
	(0.02)	(0.15)	(3.26)	(4.21)

The price attribute was a continuous variable, averaging from $0.79 for peppermint shrimp to $30 for queen angelfish. The statistically significant negative coefficients indicate that higher prices result in lower average profitability ratings for all species. At the average prices, the effects on profitability ranged from 1.42 for the orange skunk clownfish to 3.26 for the spotfin hogfish. The magnitude of these effects is within the range of the remaining significant variables.

Fish size was included only in the high-valued species experiments (i.e., angelfish and hogfish). Both the medium and large-sized angelfish increased the profitability rating above that of small angelfish (by 1.00 and 1.22, respectively). For the hogfish, only the average rating of the large fish was statistically above the small fish.

The tank-raised and guaranteed survival attributes were only included in the lower-valued species (i.e., clownfish and shrimp). The tank-raised attribute increased the average profitability rating only for clownfish, perhaps because this species is one of the few that is currently available from commercial culturing operations. The survival guarantee was statistically significant and positive, as expected, for both species. This attribute was intended to account, in part, for one benefit advocated by MAC supporters, i.e., that MAC certified specimens are expected to be healthier and thereby survive longer (reduced mortality). For these species, this result suggests that a survival guarantee could be an alternative for those firms who are already handling and transporting the specimens in a manner that results in a longer "shelf life"; in addition, the survival guarantee does not incur an automatic cost. Note that large retail pet store chains (e.g., PetSmart) currently get and offer such guarantees on freshwater specimens.

As mentioned earlier, the largest firms (in terms of marine fish sales) had lower average profitability ratings for all species. The effects were, however, some of the largest estimated as average ratings were 2.10 to 4.83 below that of smaller firms. For mid-sized firms (sales2), their profitability rating for shrimp was estimated at 1.00 higher than that of small firms.

In terms of primary function (i.e., market segment), the average ratings of wholesalers were significant for all species and lower than that of the base category (trans-shippers or distributors) by 0.94 to 3.04. This result could indicate that the wholesalers in this sample sell to trans-shippers and distributors instead of vice versa, which may reflect that a relatively large share of this species is exported due to the collection activities in Florida (Larkin et al. 2001b). As expected, the retail sector had a higher average rating for angelfish but, unexpectedly, had a lower rating for shrimp. The 'other' sector had lower profitability ratings for hogfish and shrimp; this result was unexpected but could suggest that this sector is closer to the collectors or culturists than the trans-shippers or distributors as originally hypothesized.

Whether or not the firm was located in the U.S. was only statistically significant in increasing the average profitability rating for spotfin hogfish and was not significant for the other species. This suggests that there is a relatively high degree of similarity in terms of the perceived market for these species. The ratings may be different for hogfish since it is one of the most collected species in Florida and the Caribbean (behind angelfish; Larkin et al. 2001b) and may be more specific to the U.S. market.

Firms that use "tank raised" as a marketing tool to promote sales of ecofriendly products had higher average profitability ratings for the fish species (angelfish, hogfish, and clownfish) ranging from 0.88 to 2.02. Managers, as opposed to respondents without managerial responsibilities, had lower average ratings for angelfish and hogfish. Respondents that didn't know the source of their inventory as either collected from the wild or tank-raised had lower average ratings for the fish species; specifically, ratings declined from 1.18 for hogfish to 4.11 for angelfish, which are relatively large effects compared to the other variables. In other words, it may be that less knowledgeable respondents perceived the prices to be too high ceteris paribus. In addition, firms that have purchased angelfish in the last year (handle) also had lower average profitability ratings, although those handling shrimp assigned higher ratings on average. These results could reflect a change in the overall price level of these species from the previous year. This result could also be related to that for the retail sector; among retailers that have purchased angelfish or shrimp in the previous year, average profitability ratings were 0.55 and 1.78 lower, respectively, ceteris paribus. Thus, the prices used in the experiment could be relatively high given the conditions in the retail market at the time of the survey.

Breakeven Prices

Using the estimated profitability equations in Table 6, the breakeven prices associated with each variable were calculated. This is the maximum price that the firm would be willing to pay; it is the price at which the firm will breakeven from purchasing and re-selling. The change in breakeven price represents a premium (if positive) or a discount (if negative) over the breakeven price, which represents the zero or base level of all variables (Table 4). The premiums/discounts are due to either differences in market segments, market conditions, or costs. Thus, the breakeven price would just allow the firm to cover costs and earn normal profits. For example, the breakeven base price (P_{BE}) for angelfish is \$79.19 and is calculated by solving the following equation:

$$0 = 7.1826 - 0.0907\ P_{BE}$$

Thus, by setting the left-hand-side (profitability) equal to zero and assuming all other variables (except price) equal zero, the breakeven price represents the maximum price that a small trans-shipper/distributor would pay for a small non-MAC certified angelfish assuming the firm does not promote tank-raised species, has not handled angelfish in the previous year, and is neither familiar with nor likely to adopt MAC certification. In addition, the respondent is assumed to not have managerial responsibilities but is knowledgeable about the source of all marine species. The price premiums and discounts are relative to this base product for each species. The breakeven prices for hogfish, clownfish, and shrimp were calculated at \$30.78, \$5.95, and \$1.49, respectively. Breakeven prices are summarized in Table 7 for the statistically significant variables. N/A and N/S indicate that the variable is not applicable (since it could not be estimated) or was not statistically significant, respectively, in the profitability models (Table 6).

Table 7. Breakeven Prices (premiums/discounts, $ each) for Each Variable by Species

Variable	Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
Base price (intercept only)	79.19	30.78	5.95	1.49
	(0)	(0)	(0)	(0)
Product Attributes:				
MAC	85.37	32.53	N/S	N/S
	(6.18)	(1.76)		
Medium	90.27	N/S	N/A	N/A
	(11.08)			
Large	92.66	33.83	N/A	N/A
	(13.47)	(3.06)		
Tank	N/A	N/A	7.87	N/S
			(1.92)	
Guarantee	N/A	N/A	9.07	2.21
			(3.12)	(0.82)
Firm & Respondent Attributes:				
Sales2	N/S	N/S	N/S	1.81
				(0.32)
Sales3	49.08	23.33	-1.94	0.67
	(-30.11)	(-7.44)	(-7.89)	(-0.81)
Wholesale	68.77	20.89	1.15	0.51
	(-10.42)	(-9.89)	(-4.80)	(-0.98)
Retail	94.42	N/S	N/S	0.62
	(15.23)			(-0.87)
Other	N/A	22.84	N/S	0.68
		(-7.94)		(-0.81)
Domestic	N/S	33.53	N/S	N/S
		(2.75)		
Promote	101.49	33.88	8.14	N/S
	(22.30)	(3.10)	(2.18)	
Handle	57.89	N/S	N/S	1.79
	(-21.30)			(0.30)
Manager	58.51	26.18	N/S	N/S
	(-20.68)	(-4.60)		
DKnow	33.85	26.60	1.78	N/S
	(-45.34)	(-4.18)	(-4.17)	
F_MAC	50.47	25.95	7.44	N/S
	(-28.73)	(-4.83)	(1.48)	
VF_MAC	47.51	25.86	N/S	1.83
	(-31.68)	(-4.92)		(0.35)
L_MAC	60.49	28.06	N/S	N/S
	(-18.70)	(-2.71)		
VL_MAC	N/S	N/S	3.99	1.87
			(-1.96)	(0.38)

MAC certification would increase breakeven prices by $6.18 (8%) and $1.76 (6%) for angelfish and hogfish, respectively. By comparison, the larger angelfish would increase breakeven prices by $11.08 (14%) for a medium and $13.47 (17%) for a large. The size effect for hogfish was not as great; a large hogfish would increase the breakeven price $3.06 or 10%. If a clownfish were tank-raised as opposed to collected from the wild, the breakeven price would increase $1.92 or 32% indicating a significant price premium for this cultured product (which could be due to its novelty in the marketplace at this time). The survival guarantee, the final product attribute, would increase the breakeven price from $0.82 (shrimp) to $3.12 (clownfish), which represents between a 52% and 55% increase. This is a relatively large effect for a product attribute. Recall that this attribute may reflect some of the benefits offered through the MAC certification program. These results suggest, however, that survival guarantees are preferred and perhaps more effective than MAC certification given the size of the effects.

The largest firms in terms of gross receipts in 2000 have breakeven prices that are lower than their smaller counterparts by $0.81 to $30.11 (38% to 55%) for shrimp and angelfish, respectively. Thus, larger firms are willing to pay much less for the same product. This result could reflect price discounts for large volume orders. Wholesale firms also have lower breakeven prices, from $0.98 to $10.32 (for shrimp and angelfish, respectively), compared to trans-shippers/distributors. For angelfish, retailers are willing to pay up to $94.42 or 19% more than trans-shippers/distributors. Conversely, the other sector is willing to pay much less, the breakeven prices for hogfish and shrimp declined $7.94 (26%) and $0.81 (55%), respectively. Since the harvest to retail mark-up can be ten-fold (Larkin et al. 2001a), these price premiums/discounts are considered reasonable.

U.S. firms differ from their foreign counterparts in their willingness to pay a higher price for hogfish; the breakeven price for hogfish increased 9% for U.S. firms. The breakeven prices for all other species were independent of where the firm is located. Firms that promote species as tank-raised (i.e., value sustainability) were willing to pay from 10% to 37% more depending on the species, but only for the fish species. Thus, the market value of the "tank-raised" promotion tool is significant.

Respondents with management responsibilities were willing to pay less for angelfish and hogfish, the high-valued fish species included in the study. More specifically, the breakeven prices for managers were 15% to 26% lower. Those respondents who did not know the source of their inventory were also willing to pay from 12% to 14% less for the higher- valued fish.

Familiarity with the MAC certification program reduced the breakeven prices for the high-valued fish. If "somewhat" familiar with the program breakeven prices fell 36% for angelfish and 16% for hogfish. If "very" familiar with the program, the breakeven price for angelfish would fall 40%. In other words, these firms could be anticipating cost increases of up to 40% associated with certification as reflected in a reduction the average willingness to pay. For the lower-valued species, clownfish and shrimp, breakeven prices increased with familiarity of the MAC certification program. Since these species can also be cultured, respondents may be less willing to pay for MAC certification. Firms that are more likely to participate in the MAC certification program have lower breakeven prices (24% lower for angelfish, 9% lower for hogfish, 33% for clownfish). These shares may

represent a more accurate estimate of anticipated cost increases since they have made the decision to participate. Conversely, firms that are very likely to participate in the MAC certification program are willing to pay a 26% premium for shrimp. These firms could be anticipating a relatively large market effect for this shrimp species.

In order to calculate the joint effect of the MAC-certification variables, and for a different market segment, Table 8 summarizes the wholesale breakeven prices for MAC-certified specimens by familiarity and likelihood. For both angelfish and hogfish the breakeven prices (i.e., maximum willingness-to-pay values) declined with familiarity of the program and likelihood of participation. In addition, these effects are compounded and vary by species. The effects were largest for angelfish where breakeven prices would fall by as much as 67%. The price discount effect reached 34% for hogfish. Overall, the effects of familiarity exceed those associated with the likelihood of participating.

Table 8. Wholesale Breakeven Prices (and price discounts) Related to MAC Certification

Species	Familiarity with MAC		
Likelihood of Adopting MAC	Not	Somewhat	Very
MAC-certified Queen Angelfish:			
Not Likely	$74.95	$46.22	$43.27
	(0)	(-38%)	(-42%)
Somewhat Likely	$56.25	$27.52	$24.57
	(-25%)	(-63%)	(-67%)
MAC-certified Spotfin Hogfish:			
Not Likely	$22.64	$17.81	$17.72
	(0)	(-21%)	(-22%)
Somewhat Likely	$19.93	$15.10	$15.01
	(-12%)	(-33%)	(-34%)

Note: The breakeven base prices for a non-certified product were $68.77 and $20.89 for the angelfish and hogfish, respectively. Parentheses contain the difference from a firm that is no familiar or likely to participate.

Demand Models

Following the profitability evaluations of each profile (6 for each species), respondents were asked to identify (first) how often they would purchase a specimen with the defined profile and (second) how many specimens they would purchase. Purchase intervals were provided to facilitate the data collection; purchase intervals included: bi-weekly, weekly, bi-monthly, monthly, quarterly, bi-annually, and annually. Intervals were translated into weeks via the automatic coding functions that are available through the software used to construct the survey. The purchase quantity field was only restricted to be numeric. The estimated demand models are specified with the same variables defined in Table 4 and

used to estimate the profitability equations. Although the same set of variables is assumed to affect the quantity demanded, the hypotheses differ for many variables.

Fit of Models

As discussed under the profitability equations, the demand models were estimated using tobit analysis (which takes the probability of censored values into account). In general, the share of censored variables was larger than in the profitability models, ranging from 17% to 27% in the aggregate models. The log likelihood values associated with each model were, however, much larger (in absolute value) for the demand equations indicating a poorer fit. The LR test statistics ranged from 35.0 (hogfish) to 106.8 (shrimp), indicating that the estimated coefficients from the aggregate model are statistically different for the intermediate and retail sectors. For each species, the demands for the retail sector contained a smaller share of zero responses (6% to 19%). The higher shares of zero responses for the intermediate sector (28% to 38%) indicate that the assumed prices were more appealing to the retail sector as expected. As with the profitability models, we only discuss the aggregate results below since we are primarily interested in the entire market. In addition, the aggregate models produced between 42% and 72% statistically significant variables compared to 21% to 63% in the intermediate and retail models. Despite the higher share of non-zero demands in the retail sector, the retail model had fewer statistically significant variables (21% to 47%) compared to the corresponding intermediate model (41% to 63%). Lastly, a larger number of variables could be estimated with the aggregate data (18 or 19 versus 14 or 15 depending on the species), which allowed for the extraction of more demand-related information. Table 9 contains the estimated aggregate demand models for each species. For comparison, tables comparing the model statistics (i.e., aggregate, intermediate, and retail) and estimated demands for each species are included in Appendix B (Tables B-1 through B-5). The following section discusses the statistically significant variables from the demand models in Table 9 that used data from all firms (i.e., distinguished market sectors using the dummy variables in Table 4).

Comparison between Species

Examination of the data revealed that the average annual demand across profiles for each species was as follows: 85 queen angelfish, 66 spotfin hogfish, 348 orange skunk clownfish, and 2,255 peppermint shrimp. These averages include the reported zero values on certain profiles.

The MAC-certification attribute was negative and statistically significant in the fish species models (i.e., angelfish, hogfish, and clownfish). Thus, firms demand fewer MAC-certified fish (387 fewer angelfish, 126 fewer hogfish, and 1,746 fewer clownfish); however, note that these firms are not familiar with the program and not at all likely to participate in the program in the near future. For the angelfish and clownfish, the magnitude of reduced demand is either the largest effect in the model or second only to the variables indicating the familiarity with (and/or participate in) the certification program.

Table 9. Tobit Demand Regression Results by Species (Wald Chi-Sq in parentheses)

Variable	Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
Intercept	45.1	180.7	995.8	-23,059.0***
	(0.29)	(2.03)	(1.65)	(34.8)
Product Attributes:				
MAC	-387.0***	-126.3**	-1,745.6***	-2,020.7
	(15.4)	(5.44)	(17.6)	(0.50)
Price	-4.86***	-14.6***	-165.8	598.1
	(10.5)	(8.78)	(1.52)	(0.11)
Medium	74.7*	32.7	N/A	N/A
	(3.36)	(1.86)		
Large	-3.54	12.5	N/A	N/A
	(0.01)	(0.26)		
Tank	N/A		15.7	14.8
			(0.01)	(0.00)
Guarantee	N/A		398.8***	2,465.7***
			(10.1)	(10.8)
Firm & Respondent Attributes:				
Sales2	23.1	172.5***	1,042.2***	2,784.4***
	(0.20)	(32.7)	(23.4)	(6.95)
Sales3	-314.7***	-174.5***	-1,364.6***	19,717.7***
	(7.14)	(6.24)	(7.57)	(96.5)
Wholesale	-155.7**	87.6	521.9	26,594.6***
	(2.39)	(0.91)	(0.88)	(70.5)
Retail	-327.8***	-191.0**	-1,149.0*	22,015.3***
	(43.2)	(3.88)	(3.50)	(48.6)
Other	N/A	-130.3	-777.5	23,293.8***
		(1.73)	(1.50)	(57.0)
Domestic	100.8**	114.4***	47.7	4,139.3***
	(4.31)	(12.7)	(0.04)	(12.3)
Promote	50.5	-15.8	3.07	4,492.7***
	(0.73)	(0.17)	(0.00)	(13.0)
Handle	349.7***	76.9***	210.8	-5,294.8***
	(64.5)	(6.82)	(1.00)	(15.0)
Manager	109.3***	61.9**	201.9	-2,304.4
	(7.70)	(5.79)	(1.60)	(8.05)
DKnow	233.3***	65.6	-169.7	-2,551.6*
	(9.75)	(1.93)	(0.38)	(3.28)
MAC*F_MAC	195.6**	98.9**	1,280.9***	-815.9
	(6.11)	(3.98)	(12.9)	(0.16)
MAC*VF_MAC	414.3***	182.2***	1,332.9***	631.1
	(17.8)	(10.6)	(9.62)	(0.05)
MAC*L_MAC	168.0**	23.6	485.6*	491.8
	(5.60)	(0.30)	(0.30)	(0.05)
MAC*VL_MAC	98.9	-8.18	476.7	223.6
	(2.03)	(0.04)	(2.40)	(0.01)

The price attribute was statistically significant in only the high-valued fish species equations. The average prices for angelfish and hogfish were $30 and $11.67, respectively. Using the average prices and quantities for each species, price elasticities of demand were calculated as -1.72 and -2.58 for the queen angelfish and spotfin hogfish, respectively. Higher prices would reduce the demands for both species, however, the effect is larger for the hogfish. In particular, both demands are "elastic" such that for a given percentage price increase, demand would fall proportionately more. Thus, the markets for both species are highly competitive. The larger effect for hogfish was expected given the intense competition from around the Caribbean (Larkin et al. 2001a).

Fish size was only an attribute in the high-valued fish species equations, however, the only significant effect on demand was that of medium angelfish. If the fish was of medium size versus small, annual demand would increase by 75 fish. Note that this effect is relatively large as it represents a nearly 88% increase over the average annual demand. Perhaps the larger, more mature fish are hardier. On the other hand, the lack of significance of the largest fish class could be reflecting the fact that fish continue to grow in the tank. If a large fish is purchased, the buyer does not have as much opportunity to observe growth as the tank size will eventually constrain growth. Thus, although larger fish are more profitable, demand appears to be highest for the mid-size fish.

The annual demand for the two lower-valued species examined in this study, orange skunk clownfish and peppermint shrimp, were estimated with attributes indicating whether the specimens were tank-raised and or offered with a survival guarantee. Only the survival guarantee was significant. Thus, even though tank-raised specimens may be more profitable, they do not affect overall demand for a given species. The survival guarantee, on the other hand, significantly affected both profitability and demand. The effect on demand was roughly equal to the average demands, that is, the annual demand would more than double (increase 115% for clownfish and 109% for shrimp) if a survival guarantee were offered.

Two of the firm attributes had statistically significant (although differing) effects on the annual demand of all species, namely, the largest firms and the retailers. The effects were the same for all fish species, differing only for the invertebrate (i.e., peppermint shrimp). The largest firms and the retailers demanded lower quantities of fish, but larger volumes of shrimp. For comparison, the mid-sized firms demanded larger quantities of all species as would be expected. Wholesalers demand fewer angelfish but more shrimp. The other firms also demanded more shrimp. Overall, the demand for shrimp was larger for the larger firms and for all market sectors as compared to the trans-shippers and distributors.

Unlike in the profitability equations, the domestic (i.e., U.S.) firms demanded larger quantities of angelfish, hogfish, and shrimp. Recall that location had little effect in the profitability equations. Several other firm and respondent characteristics also affected demand levels for the angelfish, hogfish, and shrimp species. None, however, were significant for the demand for clownfish. Specifically, the demand for angelfish and hogfish was larger among firms that had purchased the species in the previous year. If the respondent was a manager, then demand would also increase for angelfish and hogfish. If the respondent did not know the source of his/her inventory as being either collected or

cultured, demand was higher for angelfish but lower for shrimp. The different result for shrimp was also found in relation to whether the respondent had purchased the species in the previous year (i.e., if so, demand was lower, perhaps indicating a bad experience or poor reputation at the time of the survey). Overall, the demand equation for shrimp (the only invertebrate examined) produced results that differed from the fish demands (in terms of the direction of the effect). Whether the results are specific to this particular shrimp species or to invertebrates as a group is unknown.

Lastly, note that three variables did not have a statistically significant effect on the demands for any of the species, namely: large size, tank-raised, and very likely to participate in the MAC-certification program. For comparison recall that all variables were statistically significant in at least one of the profitability equations.

In order to determine the unique effect of MAC 'familiarity' and 'likelihood' on the demand of a MAC-certified product, the MAC-related variables were multiplied by the MAC attribute variables. The coefficients on these interaction terms, if statistically significant, adjust the demand effect of the MAC-certification variables for respondents that are familiar with and/or likely to use the MAC-certification label. Table 10 summarizes the effect of these variables on the demands for queen angelfish, spotfin hogfish, and orange skunk clownfish. Peppermint shrimp is excluded since none of the variables related to MAC-certification were statistically significant.

Table 10. Annual Demand of MAC-Certified Fish

Species	Familiarity with MAC		
Likelihood of Adopting MAC	Not	Somewhat	Very
MAC-certified Queen Angelfish:			
Not Likely	-387	-191	27
	(0)	(196)	(414)
Somewhat Likely	-219	-23	195
	(168)	(364)	(582)
MAC-certified Spotfin Hogfish:			
Not Likely	-126	-27	155
	(0)	(99)	(281)
MAC-certified O. Skunk Clownfish:			
Not Likely	-1,746	-465	-413
	(0)	(1,281)	(1,333)
Somewhat Likely	-1,260	21	73
	(486)	(1,767)	(1,819)

Notes: Parentheses contain the change in demand from a firm that is not familiar or likely to participate.

Although firms that were not familiar with or likely to adopt MAC-certification demanded fewer MAC-certified fish, firms that were familiar (somewhat or very) with the program and somewhat likely to adopt it had larger demands. Among firms that were

not likely to adopt but were very familiar with the program, the annual increased demand for MAC-certified angelfish and hogfish would be 27 and 155, respectively. Note that these values are vastly different from the reduced demands of 387 and 126 predicted by the MAC-certification attribute. Moreover, if very familiar with the program and somewhat likely to participate, the annual demand for a MAC-certified angelfish would increase to 195 (from 27) and the annual demand for a MAC-certified hogfish would increase to 73 (from -413). Overall, these results suggest that increasing the familiarity of with the program can significantly impact demand, especially for fish species that are collected from the wild.

Comparison with Intermediate and Retail

As suggested by the LR tests, the significant coefficients and magnitude of the parameters differed by market segment (Appendix B). The demand by the intermediate segment (including trans-shippers/distributors, wholesalers, and other firms) was explained by a larger number of parameters than the retail demand. The price effect, if significant, was much larger indicating a higher elasticity of demand (*ceteris paribus*). That is, the demand by intermediate firms was more sensitive to price than the retail sector. This is expected since, at the same prices, the intermediate firms stand to gain less from handling the product.

If the product was MAC-certified, the quantity demanded by the intermediate sector would fall by a larger amount than predicted in the aggregate model. Since the MAC-certification variable was not significant in any of the retail models (or the aggregate shrimp model) but was in all of the intermediate models, the demand for MAC-certification by the intermediate sector is driving the demand effects described in the previous section. Hence, promotional effort on the MAC-certification may need to focus on the retail sector since the certification must be maintained throughout the marketing chain.

The tank-raised and survival guarantee attributes were only included in the clownfish and shrimp models. The tank-raised characteristic was not found to affect the quantity demanded in any model, perhaps because both are relatively new to the cultured market. Survival guarantees were found to affect demand and they also had a much larger positive effect on intermediate demand than on the retail sector or aggregate market.

Domestic retail demand for the fish species is very strong, driving the aggregate demand results. For example, the demands for queen angelfish and spotfin hogfish by domestic firms were approximately 2 and 3 times that indicated by the aggregate model; hence, results in the previous section underestimate demands for these species in the U.S. that could affect industry estimates of the potential benefit of MAC certification.

Probability of Purchase Models

The dependent variable in these models measures the intention to purchase. The variable equals 1 if the respondent specified they would purchase a positive quantity during the coming year and 0 otherwise. The logistic regression model is used to estimate the factors which influence purchase intention. This is accomplished by estimating the effects of each explanatory variable on the natural logarithm of the ratio of the probability of purchase to the probability of not purchasing. Statistics summarizing the estimated equations are shown in Table 11. Overall, the models fit quite well.

Table 11. Summary of Model Statistics by Species

Statistic	Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
Model Fit: -2LnL	116.1***	136.6***	116.7***	110.7***
LR Test for Ho: B = 0	92.0***	63.6***	92.0***	78.6***
Max-rescaled R-square	0.58	0.44	0.58	0.53
Observed Responses: Q =1	75.2%	75.6%	73.3%	83.3%
Percent Concordant	91.2%	86.6%	90.6%	90.4%

Notes: *** indicates the chi-squared test statistic was statistically significant at the 0.01 level indicating appropriateness of the model.

As with the profitability and demand equations, statistical significance is assessed at the 1%, 5%, and 15% levels (as identified by ***, **, and *, respectively). The estimated equations are shown in Table 12. A positive (negative) coefficient means the independent variable increases (decreases) the odds that the respondent/firm would purchase, *ceteris paribus*. Although the interpretation of the coefficient is complicated by the transformation of the dependent variable into a log odds ratio (i.e., it is not intuitive), the coefficient estimates are symmetric and thus can be compared more easily. That is, the coefficients will vary from minus infinity to plus infinity on the negative and positive sides, respectively. The odds ratios, on the other hand, are asymmetric in their effects (ranging from 0 to 1 on the negative side and 1 to infinity on the positive side) but easier to interpret. Following a discussion of the logit coefficients and their relative effects (Table 12), the odds ratios are used to present the quantitative effects.

Three variables in total were not significant in any of the models, namely: medium and large fish (which were only in the angelfish and hogfish models) and whether the firm was located in the U.S. Thus, fish size and firm location do not affect the probability that any of these species will be purchased. Conversely, three variables were statistically significant and affected the probability of purchase of each species in the same manner (i.e., positively), namely: whether a survival guarantee was offered (which was only in the clownfish and shrimp models), whether the firm purchased the species in the previous year, and if the firm was very familiar with MAC certification. Thus, the probability of purchase is higher if the survival of the product is guaranteed, the firm purchased the species in the previous year, and the firm is very familiar with MAC certification.

Table 12. Logit Regression Results of Purchase by Species (Wald Chi-Sq in parentheses)

Variable	Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
Intercept	5.04***	5.82**	-0.81	0.37
	(10.26)	(4.37)	(0.08)	(0.03)
Product Attributes:				
MAC	-2.20*	-0.43	-1.47	-4.18***
	(3.07)	(0.18)	(0.64)	(6.66)
Price	-0.12***	-0.18*	0.08	-1.02
	(18.64)	(2.73)	(0.02)	(0.64)
Medium	-0.28	0.52	N/A	N/A
	(0.16)	(0.80)		
Large	0.41	-0.07	N/A	N/A
	(0.49)	(0.02)		
Tank	N/A	N/A	1.83***	-0.40
			(8.25)	(0.44)
Guarantee	N/A	N/A	1.94***	2.62***
			(13.22)	(16.37)
Firm & Respondent Attributes:				
Sales2	-0.20	0.52	0.33	3.32***
	(0.06)	(0.31)	(0.07)	(7.43)
Sales3	-6.70***	-4.52***	-5.58***	-1.04
	(12.03)	(9.68)	(8.24)	(1.13)
Wholesale	-0.32	-4.36**	-2.77	-1.95
	(0.10)	(5.24)	(1.73)	(1.57)
Retail	0.51	-4.93**	-3.26*	-0.93
	(0.38)	(6.47)	(2.19)	(0.36)
Other	N/A	-5.37***	-1.77	-1.37
		(7.50)	(0.59)	(0.91)
Domestic	-1.18	0.30	0.59	0.88
	(1.91)	(0.13)	(0.40)	(1.13)
Promote	2.03**	1.54**	2.79***	-0.31
	(4.43)	(4.02)	(8.41)	(0.16)
Handle	1.33**	2.58***	2.53***	2.34***
	(3.90)	(15.71)	(6.76)	(9.14)
Manager	-2.04***	-0.50	0.21	0.45
	(9.34)	(0.62)	(0.09)	(0.51)
DKnow	-1.07	1.12	4.18***	0.22
	(1.09)	(1.34)	(12.33)	(0.05)
MAC*F_MAC	0.28	0.72	2.41*	0.31
	(0.05)	(0.34)	(2.95)	(0.05)
MAC*VF_MAC	3.70**	3.41**	3.82*	3.64*
	(4.36)	(4.26)	(3.63)	(3.69)
MAC*L_MAC	1.84*	0.07	-1.07	3.25**
	(2.93)	(0.00)	(0.32)	(5.71)
MAC*VL_MAC	3.92***	-0.08	-0.52	4.84***
	(6.81)	(0.00)	(0.07)	(9.27)

In terms of the relative size of effects, the symmetric coefficient estimates ranged from -6.7 to 4.8. In general, the negative effects were larger and most frequently associated with firm size and market position within the distribution chain, especially for the spotfin hogfish. The largest firms were less likely to buy the fish species (*ceteris paribus*, i.e., at the same price). The wholesale, retail, and other market positions were less likely to buy than the trans-shippers distributors, *ceteris paribus*. Although MAC certification would reduce the probability purchase, familiarity with or likelihood of using the program could change the effect to positive. If firms promote "tank-raised" species, the probability of purchasing any of the fish species increased.

The probability of purchasing queen angelfish is lowest for the largest firms. The probability is also reduced (to a lesser extent) if the fish is MAC-certified or a manager is buying. The negative effect associated with the price variable indicates the product is a normal economic good in that the probability of purchase and price are inversely related. On the positive side, those likely and very likely to participate in the MAC certification program and those very familiar with the certification system have the highest probabilities of purchase. The promotion of tank-raised species and experience handling the product (as proxied by whether they purchased it in the past year), as previously mentioned, also increased the probability that angelfish would be purchased. The primary difference with hogfish is the alternative market locations/positions have the lowest purchase probabilities. The clownfish equation is unique in that if tank-raised or covered by a survival guarantee the probability of purchase would increase; however, these effects were either smaller than estimated with different species or smaller in magnitude than all other statistically significant variables. Perhaps most surprising is the relatively large coefficient (4.18) reflecting the effect if the respondent did not know the source of all inventory; those less knowledgeable would have a higher probability of purchasing orange skunk clownfish.

As stated previously, the coefficient estimates cannot be easily interpreted since they represent the effects on the log of the odds of purchase and not the probability of purchase directly. One way to quantify the magnitude of the coefficients is to examine the odds ratios directly. Although odds ratios are asymmetric (e.g., odds ratios of 3.0 and 0.33 indicate the same difference in odds as verified by taking the natural log), they contain the same information as the logits (i.e., estimated coefficients in the logistic models) and are more intuitive. In general, a partial odds ratio is a summary measure indicating both the strength and direction of the relationship between the dependent variable and each dependent variable. Table 13 contains the odds ratios associated with the statistically significant variables in descending order by the direction of the effect (i.e., positive or negative).

If the odds ratio is 1, then a change in the independent variable is not associated with a change in the odds that the product/species will be purchased. Since all independent variables but price are binary, the change in the independent variable is whether the product, firm, or respondent attribute is present. Continuous variables, such as price, typically have odds ratios near 1; these ratios, however, need to be adjusted by the assumed change in price which will usually increase the ratio estimate. One last note,

if the confidence interval includes the value of 1.0, the variable is not considered a useful predictor even if it was statistically significant.

Table 13. Significant Odd Ratios in Descending Order by Species

Q. Angelfish	S. Hogfish	O.S. Clownfish	P. Shrimp
		Variables with a Positive Effect on the Odds of Purchase	
Promote (7.58)	MAC*VF_MAC[b] (19.5)	Promote (16.3)	Sales2 (27.8)
MAC*VL_MAC (5.58)	Handle (13.2)	Handle (12.5)	Guarantee (13.7)
Handle (3.80)	Promote (4.65)	Guarantee (6.94)	Handle (10.4)
MAC*VF_MAC (3.32)		Tank (6.24)	MAC*VL_MAC (1.93)
		MAC*VF_MAC[a,b] (3.86)	
		MAC*F_MAC[a,b] (2.56)	
		Variables with a Negative Effect on the Odds of Purchase	
Sales3 (0.001)	Other (0.005)	Sales3 (0.004)	MAC (0.015)
MAC[a] (0.111)	Retail (0.007)	Dknow (0.015)	MAC*L_MAC (0.39)
Manager (0.130)	Sales3 (0.011)	Retail[a] (0.038)	MAC*VF_MAC[a] (0.58)
Price (0.235)	Whole (0.013)		
MAC*L_MAC[a] (0.70)	Price (0.661)		

Notes: Parentheses contain the odds ratios. The odds ratio for the price effect is calculated assuming a price change equal to one standard deviation. '[a]' indicates variables whereby the 95% confidence interval on the odds ratio included the value of 1.0 and, thus, may not be useful. The odds ratios on all MAC interactive variables were based on the joint effect of the MAC variable and the interactive variable (i.e., assume the product is MAC-certified. '[b]' indicates that the underlying MAC variable was not statistically significant.

Table 13 separates the variables that increase the probability of purchase from those that decrease the probability of purchase. Among the variables that increase the odds of purchase, the odds ratios ranged from 1.93 to 27.8. The higher effect

corresponded to a larger firm size; in particular, the odds that a mid-sized firm (whose annual sales range from $100,000 to $1 million) will purchase peppermint shrimp are 27.8 times higher than for firms in the smallest sales category (i.e., less than $100,000 annually). Or, interpreted as a percentage increase in the odds, the odds that a mid-sized firm will purchase peppermint shrimp increase 2,680% (*ceteris paribus*) above that for firms in the smallest sales category.

The smallest positive effect on the odds ratio was recorded for those firms that are very likely to participate in the MAC-certification program; the odds of purchasing a MAC-certified peppermint shrimp change by 193% (increase by 93%) for a firm that is very likely to carry MAC-certified specimens as compared to a firm that is not at all likely to carry MAC-certified specimens. Note that this is not saying that the probability of purchase increases 93%. To calculate the percentage increase in probability, we first need to find the original odds ratio (i.e., 83.3%/16.7% or 4.99) and multiply by the odds ratio of 1.93 and set the result equal to $x/(1 - x)$ and solve for x (the new probability). In this example, the new probability is 90.6% such that firms very likely to participate in the MAC certification program increase the probability of purchase by approximately 7.3 percentage points (or nearly 9%). For comparison, the probability that these firms purchase angelfish would increase 19.2 percentage points (or nearly 26%). Similarly, firms that are very familiar with the MAC certification program increase the probability of purchasing MAC-certified angelfish, hogfish, and clownfish by 21%, 30%, and 25%, respectively. Thus, although the odds ratios may appear high, their effects must be compared to the original odds (which range from 2.74 for orange skunk clownfish to 4.99 for peppermint shrimp), which can neutralize the large odds ratios. Since the original odds ratios are the same, the effects on the probabilities of other variables can be inferred from the magnitude of the reported odds ratios in Table 13.

The odds of purchasing the fish species increase by factors ranging from 4.65 (hogfish) to 16.3 (clownfish) if the firm promotes "tank-raised" as a marketing tool. Similarly, firms that have purchased the species in the past have increased odds of purchasing ranging from 3.8 to 13.2 (i.e., percentage increase in the odds ratio from 280% to 1,220%). If the survival of orange skunk clownfish and peppermint shrimp are guaranteed, the odds of purchase increase 6.94 and 13.7, respectively (i.e., increase the probability of purchase by 30% and 18%, respectively).

The odds ratios below 1 indicate that the independent variable decreases the odds of purchase. In this study, the odds ratios reflecting a negative effect on the odds of purchase ranged from 0.001 to 0.7. For comparison, an odds ratio of 0.50 indicates that the odds of purchase are halved. For the fish species, the odds of purchase are lowest for the largest firms (in terms of sales); the odds of purchase by firms with annual sales between $1 million and $10 million) are 0.1% to 1.1% of the odds of purchase by a firm with sales below $100,000. These negative effects are, thus, much larger in magnitude than the positive effects. The odds of purchasing the lower-valued fish species (spotfin hogfish and orange skunk clownfish) were also significantly lower for the alternative market channels (versus trans-shippers or distributors); the odds ratios are 0.5% to 3.8% of the odds for the trans-shippers or distributors, which may carry larger product lines. Perhaps surprisingly, firms that are somewhat likely to participate in the MAC-

certification system had lower odds of purchasing queen angelfish and peppermint shrimp, although the usefulness of the former is in question since the confidence interval contained 1.0. As expected for a normal economic good, higher prices reduce the odds of purchase. If the price of queen angelfish and spotfin hogfish were to increase one standard deviation (i.e., $12.28 and $2.25, respectively), the odds of purchase are 23.5% and 66.1% of those species priced at the mean.

SUMMARY AND IMPLICATIONS

This project involved a conjoint (stated preference) analysis of two new, cultured marine species (orange skunk clownfish and peppermint shrimp). This type of analysis is designed to obtain market information for new products, particularly in regards to the product attributes that are most desired by different elements in the marketing channel (i.e., also known as "nodes of exchange" within the distribution channel). This analysis was unique in that it was conducted on the Internet and was, thus, able to include firms from around the world in a timely and cost-effective manner. This analysis contributes to the National Sea Grant initiative to "provide market analysis of potential [marine] culture species" (Sea Grant, p.23). In addition, two wild-caught marine fish species (queen angelfish and spotfin hogfish) were also included for comparison and to examine the potential for ecolabeling. The ecolabeling program for marine ornamentals was launched by the MAC in December 2001 and is currently in the testing phase. The program covers specific aspects of handling species (from collection, through transport, and up to the point of final sale) by a series of "core standards" and "best practice" documents. Ecolabeling programs in general have two inter-related goals: (1) to ensure or improve the sustainability and/or quality of the underlying resource stock and/or surrounding environment and (2) capture the increased benefits (e.g., greater profitability resulting from higher prices or lower mortalities within the marketing channel or from higher retail prices resulting from consumer demand for MAC certified products. These goals are interrelated since both are needed in order for the programs to succeed.

This conjoint analysis required respondents (trans-shippers, distributors, wholesalers, and retailers) to complete a market experiment for each species. The experiments entailed comparing and evaluating hypothetical products in terms of profitability and annual demand. The use of the Internet also provided unique information that can improve similar studies in the future. The primary results from this study are summarized by topic below.

Internet Survey Approach

- The overall response rate was between 18% and 32%, which is comparable to other types of surveys (mail and telephone).
- The username, password, time, and date stamps should be collected for each page. By only collecting this information following the completion of each "experiment" page,

information was lost with respect to potential respondents that only examined the background pages and opted not to compete the survey.

- Four market experiments were too many as indicated by a declining response rate following the third experiment. The largest reduction in response rate occurred after the first experiment, which was expected, however the response rate was identical for the following two experiments. Given that the average completion time for third experiment was only 3 minutes, respondents likely became bored with the experiments rather than pressed for time.
- Response time averaged 26 minutes excluding the first "Background" page with 13 questions. Response time ranged from 8 minutes to 55 minutes. The short time corresponded to a respondent that was already familiar with the first two pages of the survey (as determined by a previous login and submission of responses to those pages). Thus, the average underestimates the time for respondents completing the survey at the first sitting.
- Pre-testing of the survey revealed that response time might be an issue, thus, attribute importance weights were only collected on the attributes and not on each attribute level.

Respondents

- The majority of respondents were small retailers located in the U.S. Of the 35 respondents who completed at least one market experiment, 80% were located in the U.S. The majority of firms (62%) reported sales of marine fish at less than $100,000 in 2000 (i.e., the smallest sales category). Years of experience in the industry was uniformly distributed between 2 and 33. The majority of firms were retailers (51%), although a large number were wholesalers (26%) and a small number were trans-shippers or distributors (3%); the remainder (20%) indicated "other" as their primary function.
- Very few respondents were unfamiliar with the MAC-certification program. The vast majority of respondents (86%) were at least somewhat familiar with the MAC-certification program. Nearly equal numbers (83%) were at least somewhat likely to participate in the MAC-certification program.

Attribute Importance

- The most important attribute for the fish species was source (collected, collected and MAC-certified, or tank-raised), although source tied with fish size for hogfish. Survival guarantees were also important, and the most important for shrimp. Although price ranked above source in terms of importance for shrimp, "low price" ranked third (last) in importance for all the fish species.

Factors affecting Profitability

- The text described results from the aggregate model in order to assess the market as a whole and include additional explanatory variables.

- MAC certification was found to increase the profitability ratings for the high-valued fish species (queen angelfish and spotfin hogfish); however, the magnitude of this effect was relatively small.
- A survival guarantee was found to increase the profitability ratings for the low-valued species (orange skunk clownfish and peppermint shrimp). Since MAC certification is intended to result better handling and transport practices, which are intended to reduce mortality rates, a survival guarantee may be considered a comparable assurance tool.
- Familiarity with the MAC-certification program reduced the profitability rating for some species.
- The higher-valued fish species were also species that are of primary importance to the collection industry in Florida. The effects of a number of variables (namely, those defining participants in the market channel and whether the firm was located in the U.S.) were similar for these species.
- The average profitability rating for a firm located in the U.S. differed from foreign firms only for hogfish. This result may reflect that U.S. firms receive this species from either Florida waters or imported from elsewhere in the Caribbean.
- Firm size, market channel/position, and whether the respondent had any managerial duties were found to affect the profitability of a given product, although most effects were species-specific.

Ecolabeled Marine Ornamentals

- The estimated conjoint profitability models were used to calculate breakeven prices for alternative product profiles; we were able to calculate this price since the ratings were anchored at zero (breakeven price) and price was estimated as a continuous variable using the range of observed values. Using this model, breakeven prices represent the maximum willingness-to-pay. The difference in breakeven prices reflect price premiums or discounts.
- The MAC-certification premium was estimated at 6% to 8% for the high-valued fish by small trans-shippers or distributors that are not familiar or likely to participate. This may appear low compared to the 30% to 40% premiums recently estimated for organic products (Lohr; Nimon and Beghin); however, the MAC-certification premiums consider the associated costs (i.e., are adjusted for the costs required to carry the label).
- The value of the MAC ecolabel depends on the species and the respondents' level of knowledge of the program. In general, an increasing familiarity with and/or likelihood of participating in the ecolabeling program, reduced the breakeven price thus indicating that a discount would be needed. The MAC-certification premium increased to 8% to 9% for small wholesalers that are not familiar or likely to participate; however, the premiums fell by as much as 67% for respondents who are very familiar and likely to participate. Hence, costs of participating in the MAC-certification program may be anticipated to increase as much as 67%.

- Among firms that were not likely to adopt but were very familiar with the program, the annual increased demand for MAC-certified angelfish and hogfish would be 27 and 155, respectively. Moreover, if very familiar with the program and somewhat likely to participate, the annual demand for MAC-certified angelfish would increase to 195 (from 27) and the annual demand for MAC-certified hogfish would increase to 73 (from -413). Overall, these results suggest that increasing the familiarity of the program can significantly impact demand, especially for fish species that are collected from the wild.
- The odds of purchasing a MAC-certified peppermint shrimp increase by 93% for a firm that is very likely to carry MAC-certified specimens as compared to a firm that is not at all likely to carry MAC-certified specimens, which translates to an increase in the probability of purchase by nearly 9%. For comparison, the probability that these firms purchase angelfish would increase nearly 26%. Firms that are very familiar with the MAC certification program increase the probability of purchasing MAC-certified angelfish, hogfish, and clownfish by 21%, 30%, and 25%, respectively.

Factors affecting Annual Demand

- The price elasticity of demand for queen angelfish and spotfin hogfish were -1.72 and -2.58, respectively, which indicates that the markets for both are highly competitive and price changes would result in proportionately larger quantity changes.
- The demand for MAC-certified fish by firms that were neither familiar with or likely to participate in the program was lower, on average, than for non-certified fish; however, among those firms that are familiar with the ecolabel, demand would actually increase (especially if the firm was also likely to participate).
- The demand effect from MAC-certification was particularly strong for the intermediate firms (i.e., all except retailers). These results are shown in Appendix B.
- If a survival guarantee were included, the annual demand for orange skunk clownfish and peppermint shrimp would increase 115% and 109%, respectively.
- In general, the fish and invertebrate demand equations differed in the both the signs and magnitude of the effects of the explanatory variables. The largest firms and retailers demanded fewer fish and more shrimp on average. If a firm had purchased the species during the previous year, if a respondent was a manager, or did not know the source of his/her inventory then the demand for the high-valued fish species would increase while that of the low-valued shrimp would fall.

Factors affecting the Probability of Purchase

- Firm location did not affect the probability that any of these species will be purchased. In other words, firms in the U.S. are not more or less likely to purchase any of the species.

- The probability of purchase is higher if the survival of the product is guaranteed, the firm purchased the species in the previous year, and the firm is very familiar with MAC certification.
- The largest firms were less likely to buy the fish species (*ceteris paribus*, i.e., at the same price).
- The wholesale, retail, and other market positions were less likely to buy than the trans-shippers distributors, *ceteris paribus*.
- Although MAC certification would reduce the probability of purchase, familiarity with or likelihood of using the program could change the effect to positive.
- The odds that a mid-sized firm (whose annual sales range from $100,000 to $1 million) will purchase peppermint shrimp are 27.8 times higher than for firms in the smallest sales category (i.e., less than $100,000 annually).
- Firms that have purchased the species in the past have increased odds of purchasing ranging from 3.8 to 13.2 (i.e., percentage increase in the odds ratio from 280% to 1,220%).
- If the survival of orange skunk clownfish and peppermint shrimp is guaranteed, the odds of purchase increase 6.94 and 13.7, respectively (i.e., increase the probability of purchase by 30% and 18%, respectively).

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APPENDICES

APPENDIX A: Profitability Model Comparisons by Species

Table A-1. Comparison of Profitability Model Statistics by Species

	OLS	Tobit	Tobit	
Model Statistics	All firms	All firms	Intermediate	Retail
Queen Angelfish				
N	186	186	84	102
N non-censored ($-5 < \pi < 5$)	N/A	149 (80%)	60 (71%)	89 (87%)
N right-censored ($\pi = 5$)	N/A	15 (8%)	8 (9%)	7 (7%)
N left-censored ($\pi = -5$)	N/A	22 (12%)	16 (20%)	6 (6%)
Stat. significant parameters	78%	78%	50%	79%
R^2 for OLS, LnL for Tobit	0.59	-363.5	-165.4	-186.2
Spotfin Hogfish				
N	180	180	84	96
N non-censored ($-5 < \pi < 5$)	N/A	155 (86%)	69 (82%)	86 (90%)
N right-censored ($\pi = 5$)	N/A	10 (6%)	3 (4%)	7 (7%)
N left-censored ($\pi = -5$)	N/A	15 (8%)	12 (14%)	3 (3%)
Stat. significant parameters	74%	74%	53%	86%
R^2 for OLS, LnL for Tobit	0.47	-350.7	-162.6	-163.4
Orange Skunk Clownfish				
N	180	180	84	96
N non-censored ($-5 < \pi < 5$)	N/A	138 (76%)	60 (71%)	78 (81%)
N right-censored ($\pi = 5$)	N/A	21 (12%)	9 (11%)	12 (13%)
N left-censored ($\pi = -5$)	N/A	21 (12%)	15 (18%)	6 (6%)
Stat. significant parameters	63%	53%	53%	29%
R^2 for OLS, LnL for Tobit	0.50	-363.8	-156.0	-191.5
Peppermint Shrimp				
N	210	210	102	108
N non-censored ($-5 < \pi < 5$)	N/A	159 (76%)	70 (69%)	89 (82%)
N right-censored ($\pi = 5$)	N/A	29 (14%)	15 (15%)	14 (13%)
N left-censored ($\pi = -5$)	N/A	22 (10%)	17 (16%)	5 (5%)
Stat. significant parameters	58%	58%	39%	29%
R^2 for OLS, LnL for Tobit	0.46	-413.5	-204.3	-190.1

Note: All tobit models converged.

Table A-2. Profitability Regression Results for Queen Angelfish

	OLS	Tobit	Tobit	
Variable	All firms	All firms	Intermediate	Retail
Intercept	5.58***	7.18***	9.05***	11.8***
	(4.97)	(42.2)	(13.4)	(48.0)
Product Attributes:				
MAC	0.76***	0.56*	0.75	0.42*
	(2.59)	(3.46)	(1.57)	(2.0)
Price	-0.10***	-0.09***	-0.12***	-0.08***
	(-7.13)	(39.5)	(16.7)	(29.9)
Medium	0.83**	1.00***	1.21*	0.74*
	(2.22)	(6.70)	(2.46)	(3.74)
Large	1.47***	1.22***	1.81**	0.76**
	(3.91)	(10.7)	(5.81)	(4.14)
Firm & Respondent Attributes:				
Sales2	-0.92**	-0.33	-1.61	-0.31
	(-2.10)	(0.64)	(1.30)	(0.41)
Sales3	-5.01***	-2.73**	-3.16	N/A
	(-4.07)	(4.94)	(1.70)	
Wholesale	-0.48	-0.94*	-1.69*	N/A
	(-0.76)	(2.39)	(3.30)	
Retail	1.73***	1.38**	N/A	N/A
	(2.97)	(5.89)		
Domestic	-0.28	0.45	-0.10	0.12
	(-0.59)	(1.03)	(0.01)	(0.02)
Promote	1.66***	2.02***	1.91*	N/A
	(2.70)	(10.3)	(3.00)	
Handle	-0.50	-1.93***	-2.26	-2.36***
	(-0.88)	(11.3)	(1.69)	(18.9)
Manager	-2.32***	-1.87***	-1.42	-2.39***
	(-6.10)	(26.4)	(1.93)	(29.2)
DKnow	-3.33***	-4.11***	N/A	-4.78***
	(-4.29)	(27.1)		(45.4)
F_MAC	-1.89***	-2.60***	-3.70*	-2.59***
	(-2.82)	(15.4)	(3.33)	(4.95)
VF_MAC	-2.00***	-2.87***	-3.86**	-3.61***
	(-2.90)	(17.8)	(4.43)	(7.82)
L_MAC	-1.34**	-1.70***	-1.17	-2.00**
	(-2.32)	(9.05)	(0.91)	(6.11)
VL_MAC	0.59	0.09	N/A	0.20
	(1.02)	(0.02)		(0.06)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit.

Table A-3. Profitability Regression Results for Spotfin Hogfish

	OLS	Tobit	Tobit	
Variable	All firms	All firms	Intermediate	Retail
Intercept	11.4***	8.69***	10.3***	10.8***
	(5.47)	(22.1)	(6.58)	(40.2)
Product Attributes:				
MAC	0.58*	0.50*	0.55	0.11
	(1.96)	(3.72)	(1.71)	(0.19)
Price	-0.31***	-0.28***	-0.41***	-0.22***
	(-4.08)	(18.3)	(13.1)	(12.0)
Medium	0.73*	0.33	0.23*	0.46*
	(1.94)	(1.06)	(0.20)	(2.10)
Large	1.20***	0.86***	1.14**	1.13***
	(3.22)	(7.09)	(3.93)	(11.1)
Firm & Respondent Attributes:				
Sales2	-0.88*	-0.51	-1.76*	0.08
	(-1.91)	(1.62)	(2.92)	(0.02)
Sales3	-4.67***	-2.10**	-5.46***	N/A
	(-3.98)	(5.06)	(12.1)	
Wholesale	-6.30***	-2.79**	-5.51*	N/A
	(-3.90)	(3.96)	(3.59)	
Retail	-4.76***	-1.26	N/A	N/A
	(-2.88)	(0.86)		
Other	-6.04***	-2.24*	-6.80**	N/A
	(-3.64)	(2.52)	(5.79)	
Domestic	0.61	0.78*	1.51	5.06***
	(1.15)	(2.69)	(0.62)	(35.9)
Promote	0.57	0.88*	0.29	N/A
	(0.90)	(2.65)	(0.09)	
Handle	1.00**	-0.14	2.51**	-2.11***
	(2.14)	(0.10)	(5.57)	(20.3)
Manager	-1.85***	-1.30***	-1.60	-1.42***
	(-4.40)	(10.7)	(2.07)	(12.5)
DKnow	-0.36	-1.18*	N/A	-2.42***
	(-0.51)	(3.69)		(17.6)
F_MAC	-1.05*	-1.36***	-1.56	-6.30***
	(-1.64)	(5.94)	(0.64)	(28.9)
VF_MAC	-0.74	-1.39***	0.35	-6.67***
	(-1.18)	(5.94)	(0.06)	(29.9)
L_MAC	-0.93*	-1.76*	2.47	-1.93**
	(-1.80)	(9.05)	(0.71)	(6.27)
VL_MAC	-0.32	-0.20	3.04	-1.13*
	(-0.56)	(0.15)	(1.38)	(2.66)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit

Table A-4. Profitability Regression Results for Orange Skunk Clownfish

	OLS	Tobit	Tobit	
Variable	All firms	All firms	Intermediate	Retail
Intercept	4.58**	3.65*	8.45	3.72*
	(2.23)	(2.76)	(1.91)	(2.15)
Product Attributes:				
MAC	0.50	0.35	0.73	-0.09
	(1.07)	(0.51)	(0.97)	(0.02)
Price	-0.67*	-0.61*	-1.69***	0.21
	(-1.79)	(2.35)	(7.49)	(0.19)
Tank	1.28***	1.17**	1.43**	0.97*
	(3.01)	(6.42)	(4.08)	(3.11)
Guarantee	1.87***	1.91***	1.85***	2.24***
	(5.68)	(28.9)	(12.3)	(25.8)
Firm & Respondent Attributes:				
Sales2	-0.58	-0.41	-2.57	-0.57
	(-0.96)	(0.43)	(1.53)	(0.37)
Sales3	-5.99***	-4.83***	-6.03***	N/A
	(-5.02)	(16.0)	(17.5)	
Wholesale	-3.99**	-2.94**	-8.59**	N/A
	(-2.48)	(2.91)	(5.95)	
Retail	-2.38*	-1.86	N/A	N/A
	(-1.52)	(1.39)		
Other	-2.34*	-1.13	-6.36***	N/A
	(-1.45)	(0.48)	(8.54)	
Domestic	-0.08	0.32	4.41	-0.10
	(-0.13)	(0.32)	(2.06)	(0.01)
Promote	1.22*	1.34*	-1.00	N/A
	(1.78)	(3.59)	(0.80)	
Handle	0.62	0.41	-0.90	-0.28
	(1.05)	(0.42)	(0.21)	(0.15)
Manager	-0.60	-0.43	-2.55**	-0.25
	(-1.29)	(0.77)	(4.36)	(0.10)
DKnow	-4.37***	-2.55***	N/A	-2.24**
	(-5.46)	(7.59)		(6.54)
F_MAC	0.51	0.91*	0.45	-0.38
	(0.83)	(2.08)	(0.05)	(0.05)
VF_MAC	1.20*	0.98	3.60*	0.30
	(1.77)	(2.06)	(2.41)	(0.02)
L_MAC	-0.76	-0.18	7.77*	-1.41
	(-1.31)	(0.09)	(2.15)	(1.21)
VL_MAC	-1.46**	-1.20*	-1.27	-1.37
	(-2.30)	(3.26)	(0.11)	(1.49)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit

Table A-5. Profitability Regression Results for Peppermint Shrimp

	OLS	Tobit	Tobit	
Variable	All firms	All firms	Intermediate	Retail
Intercept	2.16	4.62***	3.45	4.54***
	(1.38)	(9.13)	(1.70)	(18.4)
Product Attributes:				
MAC	0.59	0.26	0.03	0.34
	(1.35)	(0.32)	(0.00)	(0.62)
Price	-2.78***	-3.10***	-4.27***	-2.73***
	(-3.81)	(18.9)	(10.3)	(15.8)
Tank	0.36	-0.04	-0.24	0.04
	(0.91)	(0.01)	(0.12)	(0.01)
Guarantee	2.55***	2.55***	3.68***	1.58***
	(8.25)	(61.8)	(37.1)	(28.1)
Firm & Respondent Attributes:				
Sales2	1.15***	1.00**	2.86*	0.63*
	(2.63)	(5.61)	(3.57)	(2.31)
Sales3	-3.54***	-2.52***	-3.71**	N/A
	(-4.27)	(9.18)	(6.05)	
Wholesale	-2.62**	-3.04**	-3.44*	N/A
	(-2.02)	(6.25)	(3.38)	
Retail	-2.21*	-2.70**	N/A	N/A
	(-1.71)	(5.08)		
Other	-2.30*	-2.52**	-3.75*	N/A
	(-1.83)	(4.62)	(2.97)	
Domestic	-0.43	-0.27	1.48	0.20
	(-0.87)	(0.28)	(0.75)	(0.06)
Promote	0.34	0.35	1.22	0.20
	(0.58)	(0.35)	(1.29)	(0.02)
Handle	0.92*	0.92*	0.39	N/A
	(1.65)	(2.41)	(0.19)	
Manager	0.65*	-0.19	-0.81	-0.21
	(1.76)	(0.26)	(0.59)	(0.20)
DKnow	0.32	0.76	-0.30	0.69
	(0.52)	(1.35)	(0.02)	(1.36)
F_MAC	0.30	0.36	1.34	-0.78
	(0.54)	(0.42)	(0.88)	(0.48)
VF_MAC	1.60**	1.07*	3.18**	-0.29
	(2.50)	(2.72)	(4.16)	(0.05)
L_MAC	0.70	0.68	1.28	-0.28
	(1.28)	(1.73)	(0.28)	(0.15)
VL_MAC	1.45**	1.19**	1.20	0.66
	(2.35)	(4.21)	(0.31)	(0.78)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit.

APPENDIX B: Demand Model Comparisons by Species

Table B-1. Comparison of Tobit Demand Model Statistics by Species

Model Statistics	All firms	Intermediate	Retail
Queen Angelfish			
N	186	84	102
N non-censored ($Q > 0$)	140 (75%)	55 (65%)	85 (83%)
N left-censored ($Q = 0$)	46 (25%)	29 (35%)	17 (17%)
Stat. significant parameters	72%	63%	21%
LnL	-973.2	-392.5	-534.6
Spotfin Hogfish			
N	180	84	96
N non-censored ($Q > 0$)	136 (76%)	53 (62%)	84 (87%)
N left-censored ($Q = 0$)	44 (24%)	32 (38%)	12 (13%)
Stat. significant parameters	53%	47%	38%
LnL	-871.7	-343.8	-510.4
Orange Skunk Clownfish			
N	180	84	96
N non-censored ($Q > 0$)	132 (73%)	54 (64%)	78 (81%)
N left-censored ($Q = 0$)	48 (27%)	30 (36%)	18 (19%)
Stat. significant parameters	42%	53%	47%
LnL	-1,092.5	-459.2	-581.7
Peppermint Shrimp			
N	210	102	108
N non-censored ($Q > 0$)	175 (83%)	73 (72%)	102 (94%)
N left-censored ($Q = 0$)	35 (17%)	29 (28%)	6 (6%)
Stat. significant parameters	58%	41%	40%
LnL	-1,775.3	-767.4	-954.5

Note: All models estimated using left-censored tobit and all converged.

Table B-2. Demand Regression Results for Queen Angelfish

Variable	All firms	Intermediate	Retail
Intercept	45.1	153.6	-107.2
	(0.29)	(1.42)	(1.42)
Product Attributes:			
MAC	-387.0***	-644.5***	2.62
	(15.4)	(19.5)	(0.00)
Price	-4.86***	-8.29***	-3.01***
	(10.5)	(9.74)	(7.06)
Medium	74.7*	67.3	55.7*
	(3.36)	(0.92)	(3.20)
Large	-3.54	6.80	-6.23
	(0.01)	(0.01)	(0.04)
Firm & Respondent Attributes:			
Sales2	23.1	-229.6**	185.8
	(0.20)	(4.08)	(23.4)
Sales3	-314.7***	-555.2***	N/A
	(7.14)	(14.6)	
Wholesale	-155.7**	103.0	N/A
	(2.39)	(1.41)	
Retail	-327.8***	N/A	N/A
	(43.2)		
Domestic	100.8**	-27.4	205.4***
	(4.31)	(0.08)	(15.8)
Promote	50.5	108.8*	N/A
	(0.73)	(2.11)	
Handle	349.7***	532.5***	46.2
	(64.5)	(41.6)	(1.22)
Manager	109.3***	188.2*	-6.21
	(7.70)	(3.71)	(0.04)
DKnow	233.3***	N/A	-26.8
	(9.75)		(0.22)
MAC*F_MAC	195.6**	211.1	-45.6
	(6.11)	(2.01)	(0.28)
MAC*VF_MAC	414.3***	570.7***	-48.9
	(17.8)	(13.3)	(0.21)
MAC*L_MAC	168.0**	399.8**	3-2.72
	(5.60)	(5.09)	(0.00)
MAC*VL_MAC	98.9	409.9**	30.1
	(2.03)	(5.09)	(0.20)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit.

Table B-3. Demand Regression Results for Spotfin Hogfish

Variable	All firms	Intermediate	Retail
Intercept	180.7	337.9*	-258.5***
	(2.03)	(3.29)	(8.90)
Product Attributes:			
MAC	-126.3**	-133.2*	10.9
	(5.44)	(3.00)	(0.01)
Price	-14.6***	-19.8**	-8.16*
	(8.78)	(6.10)	(8.78)
Medium	32.7	-22.0	65.0**
	(1.86)	(0.34)	(6.15)
Large	12.5	7.07	17.6
	(0.26)	(0.03)	(0.50)
Firm & Respondent Attributes:			
Sales2	172.5***	-24.5	283.5***
	(32.7)	(0.14)	(56.7)
Sales3	-174.5***	-263.3***	N/A
	(6.24)	(8.52)	
Wholesale	87.6	44.9	N/A
	(0.91)	(0.13)	
Retail	-191.0**	N/A	N/A
	(3.88)		
Other	-130.3	-177.0	N/A
	(1.73)	(1.68)	
Domestic	114.4***	0.30	304.7***
	(12.7)	(0.00)	(43.8)
Promote	-15.8	34.9	N/A
	(0.17)	(0.41)	
Handle	76.9***	93.2*	30.9
	(6.82)	(3.29)	(1.00)
Manager	61.9**	132.9**	38.6
	(5.79)	(5.59)	(1.80)
DKnow	65.6	N/A	22.9
	(1.93)		(0.27)
MAC*F_MAC	98.9**	-40.0	-36.9
	(3.98)	(0.23)	(0.24)
MAC*VF_MAC	182.2***	152.5**	-139.7*
	(10.6)	(3.42)	(2.19)
MAC*L_MAC	23.6	130.3	8.07
	(0.30)	(1.86)	(0.02)
MAC*VL_MAC	-8.18	146.7*	19.6
	(0.04)	(2.17)	(0.12)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit

Table B-4. Demand Regression Results for Orange Skunk Clownfish

Variable	All firms	Intermediate	Retail
Intercept	995.8	-670.4	-197.2
	(1.65)	(0.43)	(0.54)
Product Attributes:			
MAC	-1,745.6***	-1,859.1***	-432.4
	(17.6)	(6.73)	(1.41)
Price	-165.8	-149.3	-65.2
	(1.52)	(0.43)	(0.69)
Tank	15.7	91.0	33.1
	(0.01)	(0.11)	(0.13)
Guarantee	398.8***	530.2**	182.1***
	(10.1)	(5.75)	(6.71)
Firm & Respondent Attributes:			
Sales2	1,042.2***	2,207.1***	711.8***
	(23.4)	(15.6)	(28.7)
Sales3	-1,364.6***	-749.3*	N/A
	(7.57)	(2.10)	
Wholesale	521.9	1,726.5**	N/A
	(0.88)	(5.80)	
Retail	-1,149.0*	N/A	N/A
	(3.50)		
Other	-777.5	335.7	N/A
	(1.50)	(0.22)	
Domestic	47.7	-173.2	499.3***
	(0.04)	(0.20)	(13.8)
Promote	3.07	524.2*	N/A
	(0.00)	(3.68)	
Handle	210.8	-602.1	208.7*
	(1.00)	(1.45)	(3.05)
Manager	201.9	609.2*	-176.8*
	(1.60)	(3.36)	(2.38)
DKnow	-169.7	N/A	-327.4**
	(0.38)		(6.22)
MAC*F_MAC	1,280.9***	1,106.8*	453.4*
	(12.9)	(3.04)	(2.41)
MAC*VF_MAC	1,332.9***	1,522.8**	545.5
	(9.62)	(3.92)	(2.06)
MAC*L_MAC	485.6*	328.5	-17.8
	(2.28)	(0.16)	(0.01)
MAC*VL_MAC	476.7	1,083.6	-158.2
	(2.40)	(1.80)	(0.53)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit

Table B-5. Demand Regression Results for Peppermint Shrimp

Variable	All firms	Intermediate	Retail
Intercept	-23,059.0***	-29,874.7***	1,142.4
	(34.8)	(23.5)	(0.37)
Product Attributes:			
MAC	-2,020.7	-9,154.3*	-401.4
	(0.50)	(3.24)	(0.03)
Price	598.1	4,836.2	-2,980.1**
	(0.11)	(1.74)	(6.26)
Tank	14.8	-607.6	390.6
	(0.00)	(0.10)	(0.40)
Guarantee	2,465.7***	5,588.2***	-101.2
	(10.8)	(14.3)	(0.04)
Firm & Respondent Attributes:			
Sales2	2,784.4***	4,420.2	2,680.7***
	(6.95)	(1.55)	(8.65)
Sales3	19,717.7***	17,506.0***	N/A
	(96.5)	(36.5)	
Wholesale	26,594.6***	24,543.1***	N/A
	(70.5)	(29.9)	
Retail	22,015.3***	N/A	N/A
	(48.6)		
Other	23,293.8***	21,932.9***	N/A
	(57.0)	(26.3)	
Domestic	4,139.3***	3,066.1	1,526.3
	(12.3)	(1.06)	(1.88)
Promote	4,492.7***	5,170.5**	5,502.6***
	(13.0)	(6.62)	(13.0)
Handle	-5,294.8***	-2,560.4	N/A
	(15.0)	(1.81)	
Manager	-2,304.4	-1,087.1	-5,520.7***
	(8.05)	(0.24)	(33.5)
DKnow	-2,551.6*	1,124.5	-2,138.1**
	(3.28)	(0.08)	(6.21)
MAC*F_MAC	-815.9	2,428.5	-1,437.5
	(0.16)	(0.32)	(0.77)
MAC*VF_MAC	631.1	6,668.8	-7,961.4***
	(0.05)	(1.69)	(12.4)
MAC*L_MAC	491.8	1,935.6	1,336.4
	(0.05)	(0.14)	(0.71)
MAC*VL_MAC	223.6	4,245.3	1,934.7
	(0.01)	(0.75)	(1.38)

Note: *, **, and *** indicate the variable is statistically significant at the 15%, 5%, and 1% levels, respectively, based on either the t-value for OLS or Wald Chi-square statistic for the two-limit tobit.