

HOBBYISTS' PREFERENCES FOR MARINE ORNAMENTAL FISH: A DISCRETE  
CHOICE ANALYSIS OF SOURCE, PRICE, GUARANTEE AND ECOLABELING  
ATTRIBUTES

By

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To my beloved parents Guillermo and Juanita, and brother Guillermo Jr.

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Abstract of Thesis Presented to the Graduate School  
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By

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This study presents the analysis of preferences for selected fish attributes (including the use of an ecolabel) by avid marine aquarium hobbyists for two saltwater ornamental fish and socio-demographic and attitudinal characteristics. The fish attributes included price, source (wild or tank bred), length of post-sale survival guarantee, and whether the fish was ecolabelled as certified by the Marine Aquarium Council (MAC). The fish were species commonly known to be harvested from areas with a reputation for ecosystem damage during collection (i.e., the maroon clownfish from the Philippines and the blue-faced angelfish from Indonesia). Two discrete choice experiments and the assessment of aquaria characteristics and respondents' opinions, attitudes and demographics were implemented through an Internet-based questionnaire. Respondents were solicited during a week in February 2004 from several Internet bulletin boards and discussion lists to attract hobbyists that were most likely to be familiar with the MAC.

Respondents represent a very homogeneous group, with above average levels of education, annual income, and concern about coral reefs and wild stocks protection. Half of them were not familiar with the MAC environmental certification program and a large majority preferred tank-cultured over any wild caught organism, including a certified one, in order to avoid harmful ecosystem effects associated with its capture.

Probit analyses revealed price to be only a secondary factor influencing purchase behavior. MAC certification was considered mainly as a weak substitute for competing attributes, such as an extended survival guarantee and tank culture, showing even negative effects on the likelihood to purchase. Only an increased knowledge of the MAC program, mainly at an intermediate level, and a strong association of the MAC ecolabel with effective conservation of reef habitats and wild stocks were likely to positively influence the likelihood of purchasing a MAC certified fish.

Focusing efforts on improving the credibility of the program, not only of coral reef protection but also sustainability of fish stocks, and efficient post-harvest activities (i.e., improved handling, holding and transportation) could be successful in improving preferences for a MAC ecolabel. The high level of involvement with large Internet bulletin boards and discussion lists, and the secondary role of price on purchase decisions of this hobbyist segment suggest an opportunity for increasing the effectiveness of future educational and promotional efforts by the MAC at relatively low cost.

## CHAPTER 1 INTRODUCTION

### **The Marine Aquarium Industry**

The marine aquarium industry depends upon the supply of marine ornamental species such as corals, saltwater fish and invertebrates, which are harvested from coral reefs usually located in developing countries (Wabnitz et al. 2003). In some cases, collecting aquarium fish represents the main economic activity of low-income coastal communities.

According to the last report on the global trade of marine ornamentals from the United Nations Environment Program (Wabnitz et al. 2003), the marine aquarium industry is still of relatively low volume, but it is emerging as a high value sector in terms of trade. It currently serves a market of 2 million hobbyists worldwide and generates a trade value of between \$200 and \$330 million annually. In terms of the volume of annual production, over 20 million tropical fish and about 9 to 10 million mobile invertebrates are collected, involving 1,471 and 500 species, respectively. In addition, 12 million stony corals and 390,000 pieces of soft coral representing 140 and 61 species, respectively, are also harvested and traded in the market.

The majority of organisms traded in this industry are wild-caught, as tank breeding and raising accounts for only 2% of the fish and at most 1% of the coral traded in the marine aquarium sector. This is in contrast to the freshwater aquarium industry where aquaculture provides 90% of the specimens (Wabnitz et al. 2003).

The primary sources of saltwater ornamental fish are located on the coral reef areas of Southeast Asia and the Indian and Pacific Ocean Islands, especially the Philippines and Indonesia. Other sources are located in Australia, Hawaii, Mexico, Florida, the Caribbean, Brazil, East Africa and the Red Sea (Marine Aquarium Council [MAC] 2004a).

The main destination for marine aquarium exports is the U.S. market. It accounts for 80% and 50% of the exports of stony corals and marine fish, respectively. Other important markets are located in Germany, France, U.K., The Netherlands and, on a reduced scale, Japan (Wabnitz et al. 2003).

Since most of the species traded in this market are wild-caught, the impact of the marine aquarium trade on the sustainability of its stocks and the welfare of surrounding reef ecosystems have become controversial issues. According to Holthus (2001), the most important concerns are related to

- The environmental and biological consequences of commonly applied *destructive collection methods*. One common example is the use of cyanide or other chemicals to catch aquarium specimens and live reef fish. In addition, collectors often break corals to get at stunned fish and invertebrates. These methods affect the quality and expected life span of aquarium fish throughout the commercialization chain, and they harm corals and other non-target species. Although programs to reduce the use of these chemicals have been implemented in a few countries, such as the Philippines, there has not been a reliable system to verify the method of capture for any given specimen in a way that provides any assurance for suppliers or aquarists. In addition, destructive collection methods can feed back and cause stocks of target species to decline due to loss of suitable habitat.
- The unknown potential for *overfishing* of target species that comes from uncontrolled and unmeasured effort applied in limited collection areas. The intensity of harvesting reef animals is seldom assessed, nor is the impact of harvesting on other organisms that support target species. Therefore, the industry faces the risk of allowing unsustainable harvest levels and detrimental impacts on non-target species.
- The need to collect extra specimens due to *unnecessarily high mortality rates* arising from inappropriate husbandry, handling, holding and transport practices

along the chain of custody (i.e., collectors, wholesaler, retailers). These procedures have not been subject to standard guidelines and performance monitoring. It is important to note that it is impossible to ensure a 100% survival rate for all marine ornamental species due to their particular requirements and sensitivities, but improved processes should lower mortality and reduce harvesting pressure.

In the scope of these concerns, the use of collection methods that cause minimal impacts on coral reef ecosystems and the implementation of controlled practices to minimize mortality along the supply chain have become appealing topics in the industry. If adequately controlled and managed, the industry could promote long-term, sustainable use of coral reefs, which is vital for the economic performance and sustainability of the industry as a whole and for regions where other options for income generation are limited (Wabnitz et al. 2003).

One tool that has already been initiated in an attempt to promote sustainability of the wild-caught aquaria trade is “ecolabeling” or an environmental certification scheme. The term “ecolabeling” can be generally defined as “the use of labels in order to inform consumers that a labeled product is environmentally friendlier relative to other products in the same category”(Goodland 2002, p.2). The label guarantees that the generation of a particular product does not affect either the sustainability of the resource supporting the product or the environment surrounding the resource and consumers. Thus, the general purpose of ecolabeling programs is to promote the sustainability of resources and the environment through market mechanisms.

### **An Ecolabeling Program for Live Marine Ornamentals**

The Marine Aquarium Council (MAC) was created in 1998 in response to the aforementioned concerns in the marine aquarium industry. It is an international, independent, non-profit organization that seeks to ensure the quality and health of marine ornamentals from “reef to retail.” The MAC is based in Honolulu, Hawaii and its

stakeholder network currently includes more than 3,000 aquarists, industry operators, conservationists and researchers in 60 countries. Although the program is currently funded by international partnerships, foundations and independent non-commercial sources, the goal is to support operations through fees paid by industry members for certification (MAC 2004b).

The MAC has created a third-party certification program to assure compliance with standards designed to support sustainability. Certified parties can display a label proclaiming their environmentally sound practices (i.e., collectors, exporters, importers, retailers) and products (i.e., marine aquarium ornamental fish). This program brings together collectors, importers, exporters, retailers and aquarists to accomplish a common goal. This effort became operational in late 2001, and by 2002 some certifications were already conferred. The initial scope of the program only extends to collection from the wild, but it is expected to include aquaculture practices in the future.

The ultimate purpose of the MAC ecolabel is to inform consumers (i.e., hobbyists) about reduced environmental effects caused by certified activities and empower them to promote sustainability through their purchase decisions. According to information published by the MAC (MAC 2004c), the most important objectives of the program are:

- To develop core standards to assess marine ornamental practices.
- To create a system to verify the implementation of standards and certify qualified products and practices.
- To provide a framework that allows the industry to conduct responsible collection, handling and transporting practices as well as to generate accurate data for the management of marine ornamental activities; and
- To support responsible management through education and training for industry's agents.

The core (standard) criteria developed by the MAC and used for assessment by the accredited independent certifiers deal with *coral reef conservation*, as well as with the health and sustainability of *wild stocks*. The standard criteria applied in this program are:

- *Ecosystem and fisheries management*, which addresses “in-situ” habitat, stock and species management and conservation in the collection area by verifying that management is conducted according to principles ensuring marine ecosystem conservation and stock sustainability.
- *Collection, fishing and holding*, which focuses on harvesting fish, coral, live rock and other coral reef organisms and on related activities, (e.g., handling, holding, packaging and transport prior to export) by verifying that the collection, fishing, and pre-exporter handling, packaging and transport of marine aquarium organisms do not harm the health of the collection area, the sustainable use of the marine aquarium stocks and the optimal health of the harvested organisms.
- *Handling, husbandry and transport*, which addresses the handling, husbandry, packing and transport at points along the commercialization chain in an attempt to ensure the optimal health of organisms during the commercialization process, as well as the differentiation of labeled products and practices from uncertified ones. (One important thing to note is that this standard implies that a certified product has to pass only from one MAC certified industry operator to another).

Currently, the MAC works with four internationally accredited certifiers. They have awarded the ecolabel to more than 30 agents in the industry including individual commercial firms and fishermen associations (Table 1-1). However, the number of actual certifications represents a very small portion of industry operators worldwide. Just to illustrate the situation at the collection level, in Sri Lanka alone there are reported to be approximately 50,000 individual collectors participating in the industry, and in the Philippines only 2 collectors’ associations in that area have committed to the MAC ecolabeling program, representing only 63 members in total out of approximately 7,000 (Bunting and Meyers 2002).<sup>1</sup>

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<sup>1</sup> Batasan Tropical Fish Collectors Association (BATFCA) has 31 members and Tangaran Aquarium Fish Gatherers Association (TAFGA) has 32 members actually certified by MAC. This information was

Table 1-1. MAC certified operators

Practices	Location	Number of certified agents
Collection Areas	Fiji	4
	Philippines	2
Collectors	Fiji	4
	Philippines	2
Exporters	Fiji	1
	Philippines	2
Importers	United States	3
	Canada	1
Trans-shippers	The Netherlands	1
	France	1
	United Kingdom	1
	France	1
Retailers	United States	6

Source: Marine Aquarium Council (2004d)

The implementation of the ecolabeling program for marine aquarium organisms is in its initial phase; therefore, it is too soon to draw conclusions about the achievements of the certified parties. However, opportunities for promoting a sustainable marine aquarium industry have emerged and they include (MAC 2004e):

- Creation and implementation of previously non-existent management plans for *reef conservation* in certified marine aquarium collection areas, which has involved the joint participation of fishermen and other stakeholders in establishing no-take reef reserves and fish sanctuaries in certified collection areas in the Philippines.
- Reduction in *overfishing and elimination of destructive collection practices*, such as when fishers certified by the MAC are trained to use non-harmful fishing methods, keep records of the species and the amount they harvest to generate a baseline that will allow management authorities to manage the stock sustainably, and importantly, only collect what a certified buyer has ordered, with records provided by fishermen being verified against purchasing information from certified buyers.
- *Reinforcement of sustainable livelihoods for fishers*, who have few economic options beyond harvesting marine aquarium organisms, with a positive flow-on effect to the sustainability of their communities, and a potential positive flow-on effect to other communities if the program performs as expected.

---

provided by Rezal Kusumaatmadja, Asia Director of the MAC program (personal communication, 6 July 2004).

On the other hand, the MAC program faces some challenges related to those already faced by the Marine Stewardship Council's (MSC) certification program for seafood, its predecessor.<sup>2</sup> One of the challenges relates to overcoming potentially high levels of skepticism from environmental organizations and consumers concerning the effective assessment of ecosystem impacts. In addition, issues about costs and criteria of valuation that could preclude the participation of all fisheries, as in the case of the seafood certification program, could also be applicable to the MAC program (Gardiner and Viswanathan 2003). In addition, market surveys about willingness-to-pay for certified products have shown that consumer preferences depend heavily on consumers' knowledge about the purpose of ecolabeling, their own environmental and personal interests, the degree of market development in their geographic region and even the credibility of the certification agency (Wessells et al. 1999). All of these influences may make ecolabeling inapplicable or unacceptable in some markets and reduce the scope to "niche markets" rather than a force for global improvement of fisheries management (Gardiner and Viswanathan 2003).

One important distinguishing feature of the MAC certification program is the restricted nature of the chain of custody for marine ornamentals. The system requires certified operators to work only with other operations that meet the MAC quality standards. The commercialization of certified products can only involve certified operators (i.e., collectors, wholesalers, and retailers) until the marine ornamental is sold to an aquarium hobbyist. In this aspect, the market acceptance throughout the chain is

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<sup>2</sup> The ecolabeling program for seafood fisheries was developed and implemented by the MSC. This program constituted the first third-party independent environmental certification initiative in the fisheries sector. To date, 10 fisheries have been certified and 12 more are undergoing certification assessment.

vital for the support of certified custody systems and the MAC program itself. If the market does not respond to the label and there are not enough incentives to expand these chain of custody interactions, the decrease in incentives can create an even more restricted chain of commercialization than the one envisioned by the MAC. This challenge faces the MAC and it is one significant difference with the MSC's seafood certification program where post-harvest, handling and transport issues do not exist.

A few preliminary studies have explored the effects that several fish and buyer characteristics have on purchase decisions for select ecolabelled aquarium organisms. Interestingly, preferences for the MAC ecolabel have been shown to differ among agents in the industry and fish species, at times, there are even negative effects on purchase decisions. For example, according to Rubinstein (2003), the length of survival guarantee as a fish characteristic could be preferred and perhaps considered as a more effective tool in promoting improved fish handling and transport than MAC certification. In addition, for species that can be cultured, operators may be less willing to pay for MAC certification. Moreover, the value of the MAC ecolabel can depend on species and the familiarity the buyer has with the program. In the above-mentioned study, the majority of respondents were familiar with the MAC certification program, but an increased level of familiarity reduced the profitability rating assigned by wholesalers and retailers for some certified species, specially the high value ones. In addition, those more familiar with the MAC certification (ecolabel) program had a lower maximum price they were willing to pay for the fish because of anticipated cost increases associated with becoming certified and purchasing only from certified suppliers. However, a high level of

familiarity with the program was likely to have a positive impact on demand and the probability of purchasing a certified fish, especially for wild-caught specimens.

### **Problem Statement**

As a result of the increasing concerns about the sustainability of the marine aquarium industry, the MAC ecolabeling program emerged as a voluntary market-based tool to promote the sustainability of saltwater ornamental fish and coral reef ecosystems. If demand for certified organisms is generated, the market could drive the industry toward improved environmentally-friendly production of marine ornamentals; thus, it is important to examine the influence that an environmental quality assurance attribute, like the MAC certification ecolabel, has on consumers' purchase decisions.

In addition to certification, other attributes of the product, as well as the socio-demographics and attitudes of consumers, are likely to influence purchase decisions for marine aquarium species. Since previous studies have explored fish preferences among operators within the commercialization chain for this industry, it is necessary to generate further information about preferences for marine aquarium fish at the final consumer level and to analyze auxiliary influences on purchase decisions by hobbyists. These results can be used to estimate the importance of certification and, ultimately, the potential of the MAC program to promote a sustainable marine aquarium industry.

### **Objectives and Hypotheses**

The main objective of this thesis is to determine the preferences of avid hobbyists for marine ornamental fish, through the implementation of a market experiment based on a stated preference technique. To achieve this purpose, the study implements an Internet-based survey utilizing a choice experiment format to assess the preferences of hobbyists, who are members of online aquarium discussion boards, for two species of marine

ornamental fish: the blue-faced angelfish (*Pomacanthus xanthometapon*) and the maroon clownfish (*Premnas biaculeatus*).

In this context, the broad objectives of the study are:

- To characterize a sample of highly informed marine aquarium hobbyists, (e.g., members of online discussion groups).
- To ascertain opinions regarding tank-bred and ecolabelled specimens and alternative production techniques.
- To estimate the differences in likelihood to purchase a fish with different attributes, including whether certified (i.e., ecolabelled), price, source (wild-caught vs. tank-bred) and length of survival guarantee.
- To estimate the effect that relevant characteristics of hobbyists have on their preferences for ecolabelled fish.

The specific hypotheses to be tested are listed below:

- Members of this segment are well-informed individuals, with avid participation in the hobby.
- The majority of respondents have a high level of familiarity with the MAC certification program.
- Sustainable harvest practices and conservation of reef ecosystems have significant influence on preferences for saltwater ornamental fish.
- Price is not the most important attribute affecting the purchase of marine ornamental fish.
- Environmental certification is perceived as a positive value-added attribute influencing purchase decisions for ornamental saltwater fish.
- Certified fish are likely to be preferred to cultured fish and fish with larger post-purchase survival guarantees.
- Respondents from regions normally exposed to the aquarium industry are likely to exhibit a positive preference for the MAC ecolabel.
- High levels of education, incomes, and age will positively influence preferences for a MAC certified fish.

## Potential Benefits

The information obtained from the survey is expected to be of value for several segments of the industry. One of the main potential users is the Marine Aquarium Council, since results estimate the importance and potential of the MAC ecolabel in the hobbyist market segment. These results will complement studies of ecolabeling for this industry for agents at intermediate levels of the chain of custody. In addition, the research may identify challenges to the current and future acceptance of the certification program for the hobbyist segment that can be used to tailor informational materials to increase the effectiveness and success of the program.

Other potential users are members of the industry (i.e., retailers, wholesalers, and collectors) planning to adopt certified practices, or simply interested in obtaining indicators of hobbyists' preferences for the specific attributes analyzed. This study can provide them with information for developing marketing strategies directed to the segment of avid hobbyists. Moreover, since one of the species included in the market experiments (i.e., the maroon clownfish) is available from cultured sources in Florida, information about observed preferences could also contribute to identification of market opportunities for Florida's producers of saltwater aquarium fish.

## Contents of the Study

The remainder of this document begins by introducing the concepts used to design and implement the market experiments in this research. Theoretical foundations of discrete choice modeling, as well as a brief overview of empirical applications in the literature are given in Chapter 2. Chapter 3 provides a detailed description of the methodology followed to implement the survey (i.e., design of choice experiments, sampling technique, data collection, and modeling specifications) and potential

limitations to the scope of the results. Characterization of respondents, and results of the experiments are presented in Chapter 4. Finally, summary and conclusions are discussed in Chapter 5.

## CHAPTER 2 PREFERENCE MODELING

The value that goods and services have in tradable markets can be estimated from the direct observation of historical monetary transactions. On the other hand, when the value cannot be directly obtained from a market transaction since the products have to be sold in sufficient quantities with the attributes of interest, different tools need to be used. Such tools allow the researcher to estimate the value of specific attributes by exploring and systematically analyzing consumers' preferences expressed during hypothetical market situations.

### **Alternative Valuation Approaches**

Two main techniques have been developed to obtain non-market values. One of them, known as the “revealed preference” method, uses observed consumer behavior in markets. Estimation and analysis of preferences in this context are influenced and limited to past purchase behavior and price levels.

An alternative approach bases the estimation on “stated preferences”. As its name indicates, this approach focuses on the analysis of preferences that have not been observed in a market. Instead, consumers indicate what their preferences would be across different hypothetical scenarios designed by the researcher and implemented through survey instruments. One characteristic of this valuation approach is its ability to generate preference information when no actual markets exist. This is, stated preference techniques allow the analysis of the market potential of a product prior to its introduction or the viability of new services or policies in the case of environmental valuation

(Bennett and Blamey 2001). One stated preference technique that is being increasingly used in fields like psychology, marketing, transportation and recently in environmental economics (Adamowicz et al. 1998; Haaijer 1999) is discrete choice modeling.

With this method, consumers are asked to choose their preferred product/service alternative from a small set of options. The alternatives are different profiles constructed by combining attribute levels for the good or service under analysis (i.e., characteristics and set of values defining them). The total number of possible combinations of attribute levels is called a complete factorial. In order to not overload respondents, the number of profiles presented to respondents for evaluation is usually an efficient fraction of the complete factorial.<sup>1</sup> Once selected, the efficient profiles are assigned into small groups for comparison (i.e., choice sets), according to the most appropriate method of choice set design.<sup>2</sup> The process of selecting the relevant attributes and levels, combining them to create hypothetical profiles, selecting the efficient profiles and comparing them in a choice set is known as a choice experiment.

Adamowicz et al. (1998) state that since the alternative profiles are defined in terms of product characteristics, this technique is especially helpful for studies addressing multi-attribute effects on preferences and evaluating the attribute trade-offs that individuals are willing to make. In addition, Orme (2003) considers choice exercises to be a remarkably accurate representation of the purchase process in real markets, especially in a competitive context.

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<sup>1</sup> The term efficient indicates that profiles are selected using a fractional factorial approach. Fractional factorial designs maintain the orthogonality (i.e., independence) property across attribute levels formed by complete factorials and allow particular effects to be estimated using a reduced set of profiles (Louviere et al. 2000).

<sup>2</sup> A practical description of choice set design techniques is provided by Bunch et al. (1996).

In comparison to other stated preferences techniques, such as the contingent valuation method (CVM) and conjoint analysis, the literature has identified several advantages of choice modeling. Whereas CVM focuses on consumers' willingness-to-pay for a single scenario (profile), choice modeling focuses on the valuation of preferences for attributes and attribute levels that define the profile, which allows for analysis of specific attributes and attribute levels. The main trade-off in a single CVM exercise is limited to monetary terms (e.g., price), while the choice approach allows evaluation of trade-offs among attributes (including price) and attribute levels (Adamowicz et al. 1998).

Conjoint analysis and choice experiments both evaluate alternatives derived from statistically efficient combinations of attributes. Conjoint analysis also elicits the evaluation of a wider scope of attributes and alternatives than CVM (similar to choice modeling), but the focus of the preference analysis is different than with choice modeling. Instead of choosing the preferred alternative, with conjoint analysis each of the options (profiles) receives an overall score using a rating or ranking system. The main output in conjoint analysis relates to the estimation of the acceptability of the attribute levels and the extent respondents prefer one alternative to another (Huber 1997). In contrast, with choice modeling, respondents evaluate preferences for attributes among competitive alternatives by selecting a single alternative (profile). Haaijer (1999) notes that the evaluation task in choice modeling is more realistic than rating or ranking used in conjoint analysis.

Although the choice technique offers a better possibility for multi-attribute valuation, in comparison to other stated preferences methods, it is also subject to some of

the concerns of the CVM approach. One of the most salient issues is what is called “Yea-saying” behavior. This relates to the possibility of observing strategic choices made in favor of the most acceptable alternatives (e.g., socially or environmentally) instead of real preferences. Another concern is the potential effect that not explicitly representing relevant substitutes for the attributes in the choice tasks can have on the estimation of attribute importance (Bennett and Blamey 2001).

### **Choice Modeling Theory**

Choice modeling is consistent with the concept of random utility theory (RUT). Therefore, observations obtained in a choice experiment can be analyzed with models consistent with RUT. In a choice context, RUT defines the utility perceived by consumers for a given alternative within a choice set as an unobservable construct that can be partly explained by a deterministic component. There will also always be an unexplained portion captured by a random component. Thus,

$$U_{jn}^* = V_{jn} + \varepsilon_{jn}, \quad (2.1)$$

where  $j = 1, \dots, J$  choice alternatives in choice set  $c = 1, \dots, C$  and  $n = 1, \dots, N$  individuals.  $U_{jn}^*$  is the unobserved utility perceived by individual  $n$  for alternative  $j$ .  $V_{jn}$  is the systematic, observable component of the unobserved utility of an alternative defined in terms of its attributes. Lastly,  $\varepsilon_{jn}$  is the random component of the unobserved utility related to alternative  $j$  for individual  $n$ .

Louviere (2001) developed a comprehensive general model specification of the systematic component of utility for a choice alternative:

$$V_{jn} = \beta_j + \sum_k \beta_k X_{kn} + \sum_i \delta_i Z_{in} + \sum_k \sum_i \phi_{ki} X_{kn} Z_{in} + \sum_i \sum_j \alpha_{ij} \beta_j Z_{in}, \quad (2.2)$$

where  $k = 1 \dots K$  product's attributes or characteristics and  $I = 1 \dots I$  respondents' characteristics.

In this expression,  $\beta_j$  refers to a vector representing the intercept term or a group of intercepts also known as alternative specific constants (ASC) for the  $J-1$  choice alternatives.<sup>3</sup>  $X_{kn}$  is a vector representing the choice options created by the combination of the  $k$  attribute measures.  $Z_{in}$  represents a vector of  $i$  characteristics of individual consumer  $n$ .  $X_{kn}Z_{in}$  and  $\beta_j Z_{in}$  represent vectors of relevant interactions between individual characteristics and attributes or intercepts, respectively. Interaction terms of individual characteristics with attributes or intercepts are usually introduced to account for preference heterogeneity across individuals in repeated choice exercises (Mazzanti 2001; Bennett and Adamowicz 2001).

Under the specification shown in equation (2.2), the researcher can obtain estimates for the partial utilities derived from each attribute level, which add to a total utility. The treatment of price as an attribute allows the derivation of monetary trade-offs for the attribute levels as well as discrete measures of welfare or compensating surplus among the utilities of the alternatives evaluated in the choice experiment (Irwin et al. 2002; Bennett and Adamowicz 2001).

Given the presence of a stochastic term (i.e., error), the utility obtained from an alternative cannot be completely explained by the observable attributes and, therefore,

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<sup>3</sup> Alternative specific constants (ASC) capture any variation in choices that cannot be explained by the specified covariates. ASC's are usually introduced in the alternatives' utility specification when a base option (e.g., status quo scenario or no-choice option) is part of the choice set. In such case, the ASC captures any unobserved effect (positive or negative) that influences the utility of a given alternative in comparison to the base.

can be specified only in terms of the probability of choice of such alternative. Thus, the probability of choice of a given alternative can be modeled as

$$P(j | c) = P[(V_{jn} + \varepsilon_{jn}) > (V_{ln} + \varepsilon_{ln})], \quad (2.3)$$

where  $l \neq j$  in choice set  $c$ . This expression states that the probability of consumer  $n$  choosing alternative  $j$  from choice set  $c$  is equal to the probability that the sum of the systematic and random components of option  $j$  for consumer  $n$  in such choice set is greater than the sum of the systematic and random component of alternative  $l$  within the same choice set. Through this probability modeling, the researcher obtains an indication of the relative utility generated by the alternatives, given that an individual rationally chooses the option that gives him/her the greatest utility (Bennett and Adamowicz 2001).

The assumptions made about the nature of the error terms determine in part the type of modeling to be used. The most common probability models used are the ones from the family of logits and probits. The former applies when it is assumed that errors are independent and identically distributed (IID) as a Weibull distribution, while the latter is suitable under the assumption of non-independent, non-identically distributed errors, which follow a normal distribution (Kennedy 1994).

A choice experiment provides observations about chosen and not chosen alternatives for each choice set. Therefore, each of the alternatives of a given choice set can be included in the modeling process. Indirect utility functions, such as the one presented in equation (2.2), are to be specified for each of the alternatives presented in the choice set, in such a way that parameter estimates are always constant across alternatives' utilities while any ASC for the  $J-1$  alternatives can be allowed to vary (Bennett and Adamowicz 2001). The observed choice for each alternative in a given

choice set is the dependent variable, coded as 1 for the chosen option and 0 for the non-selected options (alternatives). The explanatory variables in the models are the attribute levels specified in each alternative in each choice set and any other relevant covariates, such as the characteristics of respondents.

### **Econometric Issues in Choice Modeling**

#### **IIA Assumption**

Due to its relative computational simplicity, the models most used in empirical work have been those from the family of multinomial logit models (MNL), especially one known as the mixed conditional logit (MCL).<sup>4</sup> However, the assumption of IID errors across alternatives, choice sets and individuals implied by the logit models may not hold in reality. The direct consequence of this assumption is the so-called property of Independence of Irrelevant alternatives, (IIA), which may not apply in reality either.

The IIA property means that the introduction of additional attributes levels of a specific alternative in a choice set do not influence the choice among the other alternatives present. If this property is violated by the data, the MNL will produce inefficient estimates. As indicated by Fry and Harris (1998), in the presence of IIA violations, MNL estimates would remain unbiased and consistent, but standard errors would be inappropriate, ruling out the efficiency property in estimation.

To test for the validity of the IIA assumption in MNL models, Hausmann and McFadden (1984) developed a procedure that allows for testing the null hypothesis of no IIA violation. To do so, main effects and all 2-way interactions among attributes must be

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<sup>4</sup> The conditional logit model is a variation of the classical multinomial logit specification that deals exclusively with covariates that take different values according to choice categories, which is the case of product attributes (Liao 1994). A mixed specification refers to the addition of individual characteristics (which are choice invariant) to the basic conditional model.

introduced in the experimental design, in what is called a “mother logit” specification. If statistical tests show that estimates of the 2-way interactions in the mother logit (i.e., unrestricted) model are not different from zero when compared to the basic main effects MNL (i.e., restricted model), the IIA property is proved to hold (Haaijer 1999).

If the IIA assumption is not satisfied, several modifications to the MNL approach have been suggested in the literature. According to Orme (2003), one strategy to overcome the IIA assumption would be to analyze choice at the individual level instead of at the aggregate level. He suggests latent class and hierarchical Bayesian models as means to allow an individual-level analysis. An alternative is the nested logit model. Under this model specification respondents are assumed to first make a decision between a base alternative (which can be a constant option across choice sets or the option of not to choose) and any other alternative. If opting for an alternative different from the base, then the choice occurs at a second level or “nest”.

Other non-IID models, like the heteroskedastic extreme-value logit and probit models (binary or multinomial), can be used to allow correlation among alternatives across choice sets. The specification of the error term in these models allows residuals to be correlated not only among the random utilities of alternatives within choice sets, but also among repeated choices, avoiding IIA restrictions by definition (Haaijer 1999; Mazzanti 2001). Due to the relatively higher computational complexity of the multinomial probit, this approach is not often used.

### **Unobserved Preference Heterogeneity**

Haaijer (1999) distinguishes between 2 types of heterogeneity in the sample population. One relates to heterogeneity in tastes arising from differences in individuals' tastes that make utility functions of alternatives differ among individuals. The other

involves the influence of individual characteristics on the variance of the stochastic term (i.e. error) or on the parameters of the utility function under study. Unobserved effects influencing choice among individual respondents within the sample could arise from adaptive behavior in repeated choice tasks since previous choices can influence the subsequent ones. In the context of repeated choice, Louviere et al. (2000) states that heterogeneity can also be seen as a special form of serial correlation.

Addressing heterogeneity consists of introducing a specification of the individual specific effects on the utility function. This can be done in several ways. The most basic one is by introducing individuals' socio-demographics as explanatory variables of the utility through interactions with the attributes or with the ASC if such specification is employed.

A more elaborate approach consists of including a unique effect for each respondent as an additional intercept term, which generates a fixed effects model. The introduction of individual specific effects in the model avoids the violation of the IIA property (Mazzanti 2001). In this way, possible correlations arising from repeated choice tasks and alternatives evaluated by the same individual are allowed to contribute to the explanation of choice behavior. As observed in some empirical work, after the inclusion of socio-demographics in MNL, the IIA property has been proved to hold (Morrison et al. 1998).

Another approach is to specify individual characteristics as influencing the structure of the error term, which leads to a random effects model specification. Under this method, the stochastic component of the unobserved consumer utility (i.e., error term) consists of the traditional error term associated to each observation in the data set

and an additional term capturing any potential variation across individual respondents (Louviere et al. 2000; Kennedy 1994).

Individual characteristics can also be specified as influencing one or more parameters in a systematic way. In this sense, the specification leads to what is known as a random coefficients model that specifies utility parameters as stochastic terms varying across individuals, instead of being fixed estimates for the whole sample population (Mazzanti 2001).

### **Inclusion of a Base Alternative**

A base alternative, also called an opt-out option, is an alternative that is constant across choice sets in the experiment (i.e., included in each choice set). Besides the option of holding constant one regular profile across choice tasks, this constant alternative has been traditionally specified in two main ways. One specification introduces the base option as the current situation, product or policy (whichever is applicable), labeled as the “status quo”. Alternatively, the constant alternative can be specified as the option of not to choose. Carson et al. (1994) indicates that the “no-choice” format is more suitable when the main objective of the research is to measure market share or acceptance of the alternatives in the choice set. On the other hand, the current situation or status quo format is much more helpful when the objective is to analyze what attributes and attribute level combinations makes the hypothetical new alternatives or scenarios preferred over the current brand, policy or situation.

Banzhaf et al. (2001) and Haaijer (1999) review the main implications of introducing a constant alternative across choice sets. According to these studies one advantage of including a base alternative is that it makes the choice set a better representation of real purchase behavior in markets. This is because consumers may

always decide to delay purchase or stick to their current product or situation (i.e., choose the base), if their needs are not satisfied by the alternatives available in the marketplace. Another compelling reason to include an opt-out option is to avoid forced choices in the experiment arising from exposure only to the hypothetical profiles contained in the design. The main implication of forced choices is the potential overestimation of the real preference that respondents have for a given alternative. In other words, an alternative may be chosen in the restricted choice set when, in reality, respondents would have preferred an alternative that is not in the set or none of them. Moreover, Carson et al. (1994) remarks that the use of a constant option can enrich the analysis by allowing the estimation of market shares, viability of new products and demand.

One disadvantage of including an opt-out option is that it allows respondents to avoid making difficult choices. If the constant alternative is selected because it was the easy choice, the observed preference behavior is distorted and the usefulness of the no-choice probability to estimate market shares would be null. In addition, respondents may choose the constant option for different reasons in comparison to the remaining alternatives. In the case of a no-choice option, as Huijzer (1999) discusses, respondents could choose that option more often because there is not a clearly preferred or unattractive alternative in the choice set, not because of a real preference for that option. Again, this situation is very likely to distort real purchase preferences in the experiment.

Another disadvantage of using an opt-out option design is that no information about preferences for the attributes under analysis is provided when it is chosen, which is at odds with the main purpose of the choice exercise. In addition, including the opt-out or no-choice option is essentially adding an additional attribute level to each attribute

analyzed in the experiment. In this sense, additional complexity is created since the effect of a no-choice option on attribute level combinations needs to be introduced into the design matrix of the experiment and also into the specification of the model to analyze choice observations (Haaijer 1999).

Thus, an opt-out option may not be appropriate for each choice experiment and its inclusion would depend mainly on the focus of the preference analysis. That is, whether the study is interested mainly in preferences for attributes in an overall likelihood to purchase context or also specific utility scales among the specified alternatives.

### **Empirical Applications of Choice Modeling**

The choice modeling technique for evaluation of stated preferences was first applied in the marketing and transportation areas, covering a wide array of specific problems (Haaijer 1999). However, it has also been increasingly implemented in several additional fields (Table 2-1). Although this overview represents only a portion of actual applications, its purpose is to illustrate how issues like violation of assumptions or introduction of preference heterogeneity into the modeling have been addressed in practice, and whether they have contributed to the efficiency of results.

Most empirical studies have used unbalanced designs in their experiments, that is, where the number of levels for each attribute is not the same (Table 2-1). A wide variety of choice set sizes and number of choice tasks in the experiments have also been observed (Table 2-1). Opt-out options have been included in the experiments mainly when there is an interest on measuring preferences or market shares between the specific alternatives featured in the experiment (Table 2-1). For studies with only two alternatives per choice set, constant options are not likely to be used (Table 2-1). In those studies, the alternatives were not representing real competitors, such as brands, but were mainly

different configurations for obtaining the same product or service. This suggests that when there is no interest in the analysis of market shares for alternatives, paired alternatives in the choice sets can be appropriate, which also reduces the magnitude of the choice task faced by respondents.

Models for binary choice as well as for multinomial choices have been used (Table 2-1). The independent variables to be modeled have been either differential utility (for binary choice experiments) or total utility for each alternative. In the first case, the data set is usually constructed to include one observation per respondent per choice task, while for the second case the number of observations per response equals the number of alternatives in the choice set. Complementarily, choice modeling experiments have been implemented mainly at the aggregate level and with repeated choice tasks (i.e., several choice sets) (Bennett and Blamey 2001; Orme 2003). In the case of repeated choices, the 0/1 dependent variable observations, as well as observations of explanatory variables, are pooled for each individual. For an aggregate analysis, observations from all individuals are pooled. In addition, the functional form is generally assumed to be a simple linear specification.

For choices between two alternatives, some studies have used a binary probit specification because it allows the IIA assumption to be relaxed (Table 2-1). For the case of choices among more than two alternatives, the most common approach seems to be a conditional logit model accounting for attribute effects only, and then a test for violations of the IIA property (Table 2-1).

Table 2-1. Overview of empirical discrete choice modeling

Study	Topic	Individuals (obs.)	No. Attributes (Levels)	No. Alternatives <sup>a</sup>	Choice tasks	Model	IIA <sup>b</sup>	Heterogeneity <sup>c</sup>	Use <sup>d</sup>
Phillips et al. (2002)	Health care intervention	339 (3,366)	6 (3-6)	2	11	Binary probit	N/A	RE, D	1, 2
Irwin et al. (2002)	Neighborhood amenities	1257 (1,551)	8 (2-90)	2	2	Binary probit	N/A	RE, D	3
Lusk and Fox (2000)	Ribeye Steak	514 (27,256)	5 (2-3)	3 (NC)	18	Conditional MNL	N/A	RP	2, 4
Mazzanti (2001)	Cultural Heritage	645 (1,935)	4 (2-4)	3 (SQ)	3,4	Conditional MNL	D, HEV	RP, D	4
Alberini et al. (2003)	Environmental remediation and redevelopment	293 (2,303)	7 (2-4)	3 (NC)	4	Conditional MNL	RP	RP, D	1, 2
Wielgus and Zeitouni (2003)	Coral reefs	181	3 (3)	3 (SQ)	1	Conditional MNL	NL	D	1, 4
Riera and Mogas (2003)	Forest	1200	6 (2,4)	3 (SQ)	4	Conditional MNL	N/A	D	1, 4
Wessells et al. (1999)	Ecolabeled seafood	1640 (4,633)	3 (2-12)	2	3	Binomial logit	N/A	D	5
Blamey et al. (1999)	Water supply options	294	3 (3)	3 (FC)	9	Conditional MNL	N/A	D	2, 6, 1, 4
Morrison et al. (1998)	Wetland quality	318 (1,577)	5 (3,4)	4 (SQ, NC)	5	Conditional MNL	MLA	D	1, 4

<sup>a</sup> (NC) no choice, (SQ) status quo, (FC) fixed constant.<sup>b</sup> (HEV) heteroskedastic extreme value MNL, (NL) nested logit, (MLA) mother logit with attributes interactions.<sup>c</sup> (RE) random effects, (D) demographic interactions, (RP) random parameters.<sup>d</sup> (1) implicit price of attributes, (2) effect on probability of purchase, (3) compensating surplus for attribute changes, (4) compensating surplus for different scenarios, (5) effect on utility, (6) market shares.

To correct for violations of the IIA property, if necessary, and to account for preference heterogeneity, several additional specifications are estimated and compared in order to find the model with the best performance (Table 2-1). For IIA considerations, the main types of specifications implemented in these studies accounted for individual specific effects on observed choice (i.e., preference heterogeneity) or implemented non-IID models (i.e., models assuming non-independent, non-identically distributed errors). The introduction of individual characteristics in the basic conditional model, to generate random effects, random coefficients, mother logit and heteroskedastic extreme-value specifications, are the most likely approaches used to obtain efficient estimates (Table 2-1). Interestingly, in several studies, the basic specification (i.e., attributes only) with demographic-based interaction terms have been enough to avoid violation of the IIA assumption and to account for heterogeneity in the sample. Therefore, as Mazzanti (2001) stresses, the theoretically superior fit of more sophisticated specifications than the additive introduction of demographic interactions may not always apply in empirical studies.

### **Form of Choice Modeling Results**

The results obtained from choice models are the estimates of the effect of the attribute levels on the overall utility of a given alternative, or in other words, the partial utilities obtained from each attribute level. However, the coefficient estimates have been used to expand the scope of the analysis of applied studies (Table 2-1, final column). Using the assumed cumulative distribution function of the error term, utility estimates of the alternatives evaluated in the experiment can be transformed into probabilities of choice. Empirical studies have applied this approach by calculating changes in choice

probability given a range of different values for the explanatory variables (i.e., attributes and individual characteristics).

Additional results relate to the calculation of the attribute trade-offs that respondents would be willing to make. Such estimations are obtained by the direct ratio between the coefficients of the two attribute levels of interest. When the trade-off relates to a given attribute and the monetary term, the ratio between them reflects the implicit price of the non-monetary attribute (i.e., how much individuals would be willing to pay or need to be paid for having an additional unit of the attribute level).

Another application of utility estimates is the calculation of compensating surplus between hypothetical or actually evaluated alternatives or scenarios. In this context, compensating surplus is defined as the differential amount of money that would make individuals indifferent between a pair of scenarios because both of them provide the same level of utility.

Finally, another useful application of utility coefficients relates to the estimation of market or participation shares, specially when a constant status quo or no-choice alternative is introduced into the choice tasks. This type of analysis seems to be more appropriate for studies addressing preferences for highly competitive alternatives in real situations rather than for hypothetical options for the same product or service. A few examples of such competitive choice alternatives could be product or services brands or different policy scenarios in comparison to the current situation, as could be the case in some environmental valuation problems.

## CHAPTER 3 METHODOLOGY

One of the objectives of this study is to analyze preferences for the MAC certification status of marine aquarium ornamentals, among other selected fish characteristics. As the implementation of the MAC program is relatively recent, actual market information is not available. Therefore, valuation of hobbyists' purchase behavior with respect to this program needs to be done under the stated preference (SP) approach. The SP technique selected for this study is choice modeling. This technique is believed to be the most appropriate because the analysis is desired at the aggregate level and estimations of attribute level effects on purchase likelihood are needed. In addition, in comparison to other SP techniques, the choice format is a more realistic representation of the purchase task in real markets.

The economic foundations and empirical applications of discrete choice modeling reviewed in the previous chapter provided the basis for the design and analysis of the market experiments implemented in this research. Descriptions of the experimental design, sampling approach, questionnaire development and implementation, as well as specification of the model to analyze the data, are provided in the following sections.

### **Experimental Design**

Two choice experiments for two different types of aquarium fish were designed to evaluate hobbyists' preferences. One of the selected specimens was the blue-faced angelfish (*Pomacanthus xanthometapon*), which is a high-value specimen that is primarily collected from the wild. The second experiment estimated the importance of

fish characteristics on preferences for a more affordable and popular fish, the maroon clownfish (*Premnas biaculeatus*), which is both collected from the wild and cultured in tanks.

The next important aspect to be addressed was the selection of the fish attributes. Price, certification status, source and extent of “arrive alive-stay alive” guarantees were selected based on previously identified fish characteristics influencing preferences for marine aquarium fish at the wholesale and retail level (Rubinstein 2003; Larkin and de Bodisco 2003). Price was defined to have three levels for each species in order to capture potential non-linear effects (Rubinstein 2003). Price levels are based on actual retail prices obtained from several on-line saltwater fish stores the week prior to the survey.<sup>1</sup> Given that fish can be sold at different prices depending on size, the recorded price level corresponded to the average price for a medium-size specimen of each species, defined in inches. The alternative price levels were set at approximately 15%-30% above and below the average recorded prices, which were translated into price premiums as high as \$3 and \$15 for the maroon clownfish and blue-faced angelfish respectively. The remaining attributes each had two discrete levels. In terms of source, a fish was defined as either collected from the wild or tank-bred. The two levels of survival guarantee were set at 5 days and 14 days, which represents the length of time that fish are guaranteed to remain alive after purchase (provided handling instructions are followed). If the fish dies in the hobbyist’s aquarium during the guarantee period, the hobbyist gets a replacement fish or

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<sup>1</sup> Prices were obtained from [www.saltwaterfish.com](http://www.saltwaterfish.com), [www.thereefconnection.com](http://www.thereefconnection.com), [www.aquacon.com](http://www.aquacon.com), [www.petworldfish.com](http://www.petworldfish.com), [www.interocean.us](http://www.interocean.us), [www.etropicals.com](http://www.etropicals.com), [www.emarinefish.com](http://www.emarinefish.com), [www.liveaquaria.com](http://www.liveaquaria.com), [www.marinedepotlive.com](http://www.marinedepotlive.com), [www.aquaticretail.com](http://www.aquaticretail.com), [www.jlaquatics.com](http://www.jlaquatics.com), [www.thepetstop.com](http://www.thepetstop.com), [www.aquariumstuffers.com](http://www.aquariumstuffers.com) and [www.themarinecenter.com](http://www.themarinecenter.com).

money back. Lastly, fish were characterized as either MAC certified or uncertified (i.e., ecolabelled or not).

Each hypothetical product was defined using only three of the four attributes in order to reduce the choice task of respondents. The objective of the maroon clownfish experiment was to evaluate the influence of price, fish source and certification status on stated preferences. The blue-faced angelfish exercise featured certification status, price and length of survival guarantee as the characteristics that explain stated preferences.

Considering the number of attributes and levels defined for the exercises, a universe of  $3^1 \times 2^2$  combinations comprised the complete factorial for each experiment. These factors correspond to one attribute (price) with 3 levels and to two attributes with 2 levels. To minimize the magnitude of the task facing respondents, the smallest number of orthogonal (i.e., independent) profiles was selected using the 12 (i.e.,  $3^1 \times 2^2$ ) possible profiles for each exercise (Mazzanti 2001). This saturated design (i.e., smallest orthogonal array) consisted of five profiles and was generated using the SAS statistical program. Those generic profiles were later populated with the appropriate attributes and levels for each experiment. It is important to mention, that one of the selected profiles in each experiment featured a dominant attribute combination (i.e., an alternative that was highly likely to be chosen since it featured the lowest cost and higher levels of the remaining attributes) that was excluded from the set of alternatives. Elimination of dominant profiles is assumed not to affect the orthogonality of the design if few profiles are eliminated, and eliminations may also contribute to maintaining the efficiency of the design (Blamey et al. 1999; Irwin et al. 2002). Ultimately, four profiles formed the combinations of attributes and levels used in the construction of choice sets.

Choice sets were constructed by combining the original four orthogonal profiles in all their feasible pairs (Bunch et al. 1996). Through this method, six choice tasks of two alternatives were obtained for each experiment. These six choice tasks for each experiment were presented to each respondent for analysis (i.e., each respondent faced a total of 12 choice tasks, 6 for each species). In order to test our original assumption regarding dominant profiles in regards to the price and source attribute levels for the maroon clownfish experiments, four choice sets were modified by varying the level of source during the survey period. This approach generated four new choice sets that were treated as a second version of the originals. Table 3-1 shows all hypothetical fish bundles used in this discrete choice analysis. The original versions were shown to a portion of respondents while the second versions were shown to the remaining respondents. In this way, each individual faced a total of six choice tasks for this experiment.

Table 3-1. Definition of experimental fish profiles by species

Species	Profile no.	Price (\$/fish)	MAC Certified	Source	Survival Guarantee (days)
Angelfish	F	99.99	No	Wild-caught	14
	J	84.99	No	Wild-caught	5
	H	99.99	Yes	Wild-caught	5
	M	114.99	Yes	Wild-caught	14
Clownfish	P	24.99	No	Wild-caught	5
	T	21.99	No	Tank-bred	5
	Q	24.99	No	Tank-bred	5
	U	21.99	No	Wild-caught	5
	N	24.99	Yes	Tank-bred	5
	G	24.99	Yes	Wild-caught	5
	R	27.99	Yes	Wild-caught	5
	S	27.99	Yes	Tank-bred	5

Note that both experiments evaluated different options for a same product rather than estimating market or participation shares. That is, respondents were instructed (and it was assumed) they would only buy one fish. Therefore, an opt-out option was not

considered applicable and was not included in the design, although respondents were not prevented from leaving the choice blank.

### **Sampling Considerations**

The sample frame for this study consisted of aquarium hobbyists that were members of pre-identified online aquarium discussion boards recommended by John Brandt, member of the 2003-04 board of Directors for the Marine Aquarium Societies of North America (MASNA) as the Industry/Legislation/Ocean Conservation representative. Mr. Brandt is also a member of the U.S. Coral Reef Task Force. Specifically, the targeted respondents were members of the discussion boards of Reef.org, Reef Central, MASNA, Chicago Marine Aquarium Society (CMAS), Boston Reefers Society and Saltwater Enthusiasts Association of the Bay Area (SEABay). This convenience approach for selecting a sample frame is based on cost-effectiveness. Alternative approaches to select participants were evaluated, but they were not feasible given resource constraints.<sup>2</sup> For empirical purposes, the study examines only individual tank owners. No aquarium organizations were included in the sample.

Because it was not possible to identify individual sample units (hobbyists), the sampling technique is most appropriately considered a convenience sample. With this approach, respondents will be tank owners that visited certain pre-identified websites

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<sup>2</sup> Randomly sampling approaches would involve screening households for individuals that keep marine aquaria. Sample frames for the general population based on household information are widely used and available in survey research (e.g. phone directories, urban /rural mapping). However, this approach would be very inefficient given the relatively low incidence of marine (saltwater) aquarium ownership in the general population). The cost in terms of time, effort and money would likely exceed the value and comprehensiveness of the information obtained. Other options include searching and purchasing existing databases of aquarium hobbyists maintained by commercial marketing firms; however, one for marine aquarium hobbyists could not be found. Alternative sources include customer lists from retailers of saltwater specimens in the U.S. However, due to resource constraints and the difficulty of accessing these lists for customers located throughout the U.S., these options were not feasible.

during a certain period and voluntarily choose to complete the survey. The main implication of this approach will be a potential bias toward highly interested individuals, which means results from the survey will be specific to this market segment. Another concern is that a balanced or properly stratified sample is not guaranteed, so statistical inferences about the population of individual tank owners (hobbyists) across the United States is not possible. However, results can be applied to infer patterns in preferences for the specific segment of active and informed hobbyists that is sampled. These results can be of importance to industry members and to related organizations like the MAC.

### **Data Collection**

Due to the nature of the target sample, data collection was implemented through an Internet-based questionnaire. In comparison to traditional methods of questionnaire implementation, the use of the Internet provided more rapid response, wider geographic coverage and lower costs of implementation (Dillman 2000). In addition, it eliminates the possibility of data entry errors as responses are automatically recorded.

Two weeks before the implementation of the survey and the first contact with potential respondents, a pre-test was conducted with saltwater aquarium hobbyists known to the researchers, managers of the selected online discussion boards, and a few members of the food and Resource Economics Department and the Fisheries and Aquatic Sciences Department at the University of Florida. The test resulted in a change in species used, additional questions about familiarity with the species used in the experiment, validation of the prices used and corrections to some wording. Ultimately, the survey instrument was posted on agsurveys.org and opened to participants between February 18 (8:00 p.m.) and February 25 (noon), 2004.

The survey instrument contained four sections (Appendix A). The first section addressed information about characteristics of hobbyists' aquaria, aquarium purchases, environmental and aquarium interests, and familiarity with the MAC certification program. The next section included the two choice experiments. Before showing the actual choice sets, a brief definition of the specimens, attributes and levels, as well as a brief overview of the choice modeling approach were presented. The blue-faced angelfish was defined as being wild-caught from the Philippines. The maroon clownfish was defined as being from Indonesia if wild caught. Both countries are known to have collection practices that harm marine ecosystems according to the group of pre-testers and, for example a study by Bunting and Meyers (2002). Next, a question about the level of familiarity with each specimen was asked and instructions were provided on how to evaluate the choice tasks. Lastly, the 12 choice sets were presented, one after another on separate pages. The third section assessed socio-demographics, opinions regarding tank-bred and reef-safe (i.e., wild-caught and ecolabelled) specimens, and alternative production techniques for unique specimens. Finally the fourth section solicited voluntary comments about the survey or subject matter in general.

### **Model Specification**

Regression analysis is used to estimate the effects of attributes and individuals characteristics on purchase decisions for saltwater ornamental fish in this study. Following Random Utility Theory (RUT), the utility generated by fish alternative  $j$  in choice set  $c$  is modeled linearly according to the following general specification:

$$V_{jn} = \beta_j + \sum_k \beta_k ATT_{jk} + \sum_i \gamma_i ATT_{jk=MAC DEMOG_{in}} + \sum_m \alpha_i ATT_{jk=MAC INT_{mn}}, \quad (3.1)$$

where  $k=1,\dots,K$  fish attributes,  $i=1,\dots,I$  respondent demographic characteristics,  $m=1,\dots,M$  respondent interest characteristics, and  $n=1,\dots,N$  individuals.  $V_{jn}$  is the observable (i.e., deterministic) component of the overall utility obtained from alternative  $j$  by individual  $n$ .  $ATT_{jk}$  is the vector representing fish attribute and attribute-level combinations in alternative  $j$ .  $ATT_{jk=MAC}$  is the vector representing the level of the MAC status attribute in alternative  $j$ .  $DEMOG_{in}$  is the vector of demographic characteristics of respondent  $n$ .  $INT_{mn}$  is the vector representing opinions and interests of individual hobbyist  $n$ . To account for preferences heterogeneity across the six choice tasks in each experiment, the utility model includes an additive specification of the effects of individual characteristics on MAC purchase preferences, reflected by the interaction terms  $ATT_{jk=MAC} DEMOG_{in}$  and  $ATT_{jk=MAC} INT_{mn}$ . The coefficients  $\beta_k$ ,  $\gamma_i$  and  $\alpha_m$  represent the magnitude and direction of the influence of each vector on the overall utility generated by fish alternative  $j$  and  $\beta_j$  is the intercept term unique to each fish alternative  $j$ .

Fish alternative  $j$  would be chosen if it provides a higher utility, this is, if  $V_j > V_l$ , where  $l$  refers to another alternative in choice set  $c$ . Assuming a normal distribution for the error term, and given a paired choice set approach, the probability of fish  $j$  to be chosen over fish  $l$  can be modeled by a binary probit model. The binary probit model is selected in this analysis in order to avoid restricted assumptions about uncorrelated alternatives arising from IID models (e.g., logit models) and to overrule IIA assumptions. In addition, probit computation is relatively simple in binary choice cases.

The resulting probability of choice of fish alternative  $j$  in choice set  $c$  is expressed as

$$\text{Prob}(V_j > V_l) = \phi[V_j], \text{ or}$$

$$\text{Prob } (V_j > V_l) = \phi \beta_j + \sum_k \beta_k ATT_{jk} + \sum_i \gamma_i ATT_{jk=MAC} \text{DEMOG}_{in} + \sum_m \alpha_m ATT_{jk=MAC} \text{INT}_{mn}], \quad (3.2)$$

where  $\phi$  represents the normal cumulative distribution function (Liao 1994). The dependent variable in equation (3.2) corresponds to the observed choice for fish alternative  $j$  by respondent  $n$ , which is coded as 1 for the selected alternative and 0 otherwise. The independent variables correspond to the variables defined in the utility specification in equation (3.1). This probit model is estimated using maximum likelihood techniques.

The statistically significant coefficient estimates obtained from estimation of equation (3.2) for each species will be used to evaluate the effect of attribute levels on probability of purchase for both species.

## CHAPTER 4 SURVEY RESULTS

Results account only for respondents that completed sections one to three of the entire survey instrument, that is, with the exception of the final comments page. From a total of 666 respondents who started answering the first “page” of the first section of the questionnaire, only 615 individuals continued to the end of the third section. After excluding incomplete questionnaires, replications (as identified through identical IP addresses) and submissions from respondents less than 18 years old, 546 completed surveys remained for analysis.

The presentation of results begins with characteristics of the respondents and their level of knowledge of the industry and opinions regarding wild-caught and tank-bred species. Following the characterization of respondents, the discussion of the findings obtained from the two choice experiments is introduced. For both species, estimates of the importance of fish attributes and statistically significant individual characteristics on overall utility are discussed first. Those estimates are then used in model simulations in order to analyze the probability of purchase related to different levels of attributes and the effect that individual characteristics have on preferences for the MAC certification ecolabel.

### **Sample Description**

The majority of respondents are owners of large saltwater tanks (Figure 4-1). About 50% of respondents keep saltwater tanks with a capacity of at least 100 gallons. Around 45% of respondents maintain 25 to 100 gallon tanks, while only 5% keep tanks

of 25 gallons or less. In addition, respondents were asked about the size of any freshwater tanks they keep. Responses indicated that 34% also have a freshwater tank.

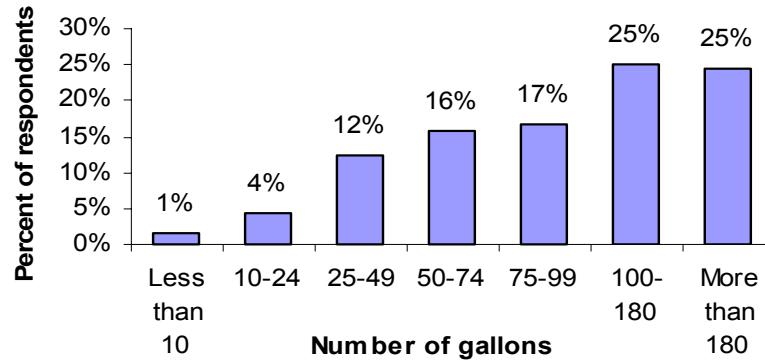


Figure 4-1. Current saltwater tank capacity reported by respondents (n = 539)

The majority of respondents (64%) indicated plans to expand their current saltwater tank capacity within the next two years (Figure 4-2). Only 2% were considering reducing it.

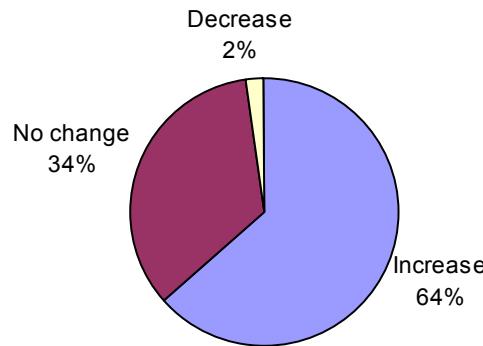


Figure 4-2. Expected change in saltwater tank capacity within the next 2 years of respondents (n = 546)

Most respondents can be classified as “intermediate length” hobbyists. Results showed that 82% have been involved in the hobby for 10 years or less, but only 17% have kept tanks for less than a year.

Respondents were asked where they expended the most money on saltwater aquarium organisms. About 65% prefer local aquarium stores and 22% spent the most on purchases through the Internet. Local general pet stores were preferred sources for 7% of respondents.

Findings indicate that respondents are willing and able to pay high prices for aquarium organisms (Figure 4-3). About 57% have paid between \$25 and \$75 for a single saltwater finfish, and 16% have paid between \$75 and \$100. Moreover, 18% have paid more than \$100 for single specimen. Respondents were also asked about the highest price ever paid for a single invertebrate. About 46% of respondents have paid between \$25 and \$75 and 19% have spent more than \$100 for a single live invertebrate organism. These preliminary observations indicate that price should not be a major constraint on purchase decisions for this group of hobbyists.

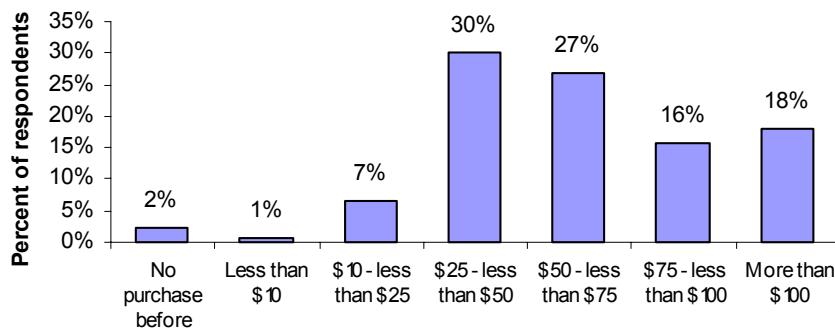


Figure 4-3. The highest price ever paid for a single fish by respondents (n = 544)

The majority of respondents reported high levels of involvement in the aquarium hobby (Figure 4-4). Around 76% of them consider keeping marine aquaria as their primary hobby and 59% are members of an aquarium society. About 19% of respondents are members of environmental organizations. In addition, 73% and 88% of participants

have conducted their own breeding and research on live marine organisms, respectively. This indicates the group of respondents as a whole has a relatively high level of involvement and interest in the hobby and also a high level of specialized knowledge. Ninety-five percent of respondents preferred purchasing a tank-bred fish to a wild-caught one. In addition to keeping a reef tank (91%), 63% of respondents have visited a coral reef. These observations imply that these respondents are most appropriately considered as avid hobbyists with a concern for the environmental effects associated with collection practices.

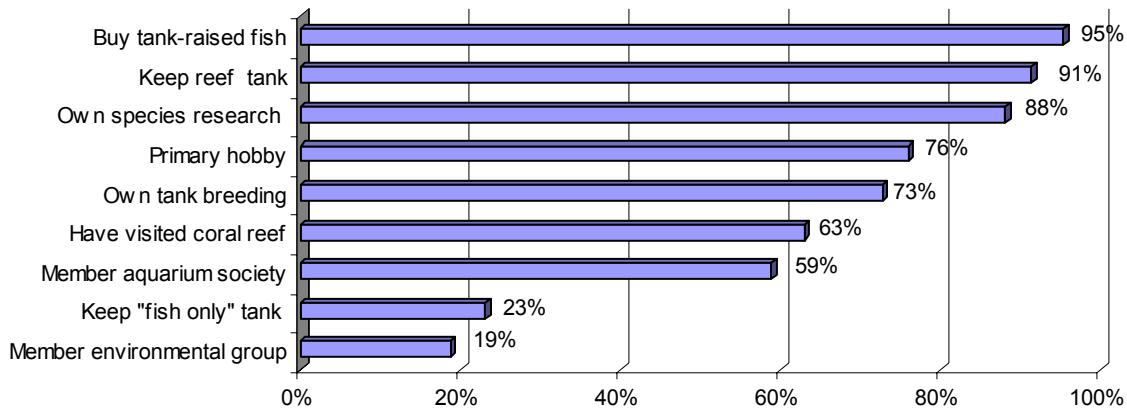


Figure 4-4. Incidence of environmental and aquarium interests of respondents (n ≥ 541), percent answering “yes”

The extent of the respondents' knowledge of the MAC certification program for marine ornamental fish was also assessed (Figure 4-5). Although respondents seem to be particularly informed about issues related to their hobby, almost half (49%) of them were not familiar with the MAC ecolabeling program. Although the remaining 51% indicated some level of familiarity, only 11% were very familiar with the program.

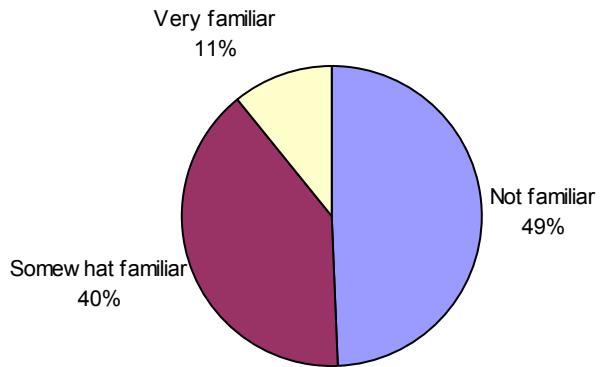


Figure 4-5. Level of familiarity with the MAC certification program among respondents (n = 545)

The importance of several issues related to reef ecosystems and specimen condition were analyzed in the context of two different sources: tank-bred and MAC-certified (ecolabelled) fish (Figures 4-6 and 4-7, respectively). Respondents were asked to rate five issues on a scale from not compelling at all to very compelling.<sup>1</sup> Tank adaptability of specimens was the most important reason to buy a cultured fish according to the respondents (i.e., 95% considered this as a compelling reason). Next, in order of importance, 94% and 86% of respondents indicated that buying a cultured fish prevented damage to coral reefs and sustained wild stocks, respectively. These findings suggest that the majority of respondents perceive wild-caught fish as less robust than cultured ones, probably due to an association with harmful collection methods. It is also suggested that respondents may actually buy cultured marine ornamentals in order to protect marine ecosystems. A potentially greater availability of cultured marine fish and the presence of regulations to protect the environment surrounding aquaculture facilities

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<sup>1</sup> Each issue was assigned scores ranging between -2 and +2 , with 0 representing no effect on purchase decisions.

appear to be less compelling reasons to buy tank-bred fish (i.e., they accounted for 60% and 59% of respondents, respectively).<sup>2</sup>

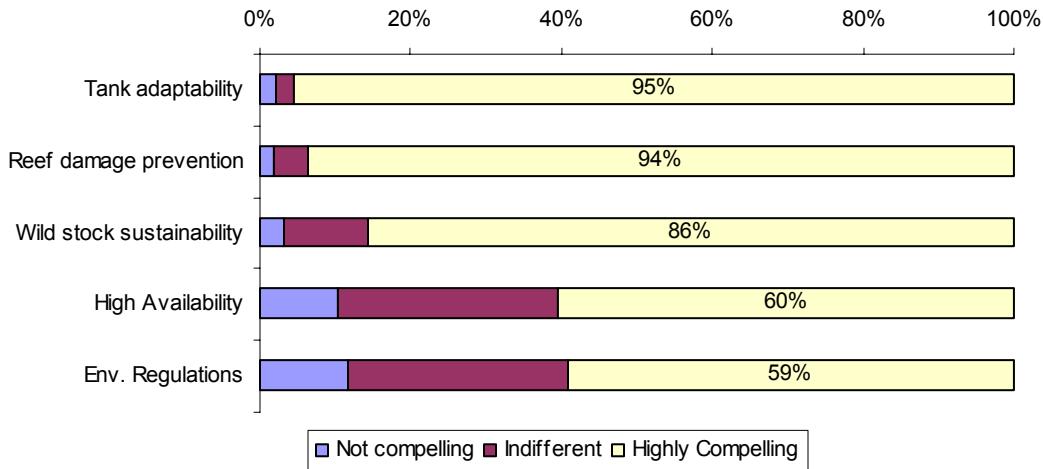


Figure 4-6. Distribution of responses regarding the importance of reasons to buy a tank-bred fish ( $n \geq 539$ )

The main reasons to buy MAC-certified saltwater fish were protection of coral reefs and sustainability of wild stocks according to 86% and 85% of respondents, respectively (Figure 4-7). These two reasons were followed in importance (on average) by the possibilities that certified fish are healthier and that certified commercialization paths prevent unnecessary mortality during collection and transport. In contrast, the environmental success of the Marine Stewardship Council (MSC) seafood certification program, the predecessor of the MAC program, appears to have less influence on purchases of certified fish (i.e., only 58% of respondents considered it as compelling). These observations also suggest a strong level of concern about reefs and wild stocks and a strong perception that wild-caught fish are harmed during collection and subsequent

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<sup>2</sup> These percentages are the ratio between the number of respondents that rated the issues as +1 or +2 and the total number of respondents assessing each issue.

handling. Overall, the protection of marine ecosystems by the MAC certification program seemed very important to respondents.

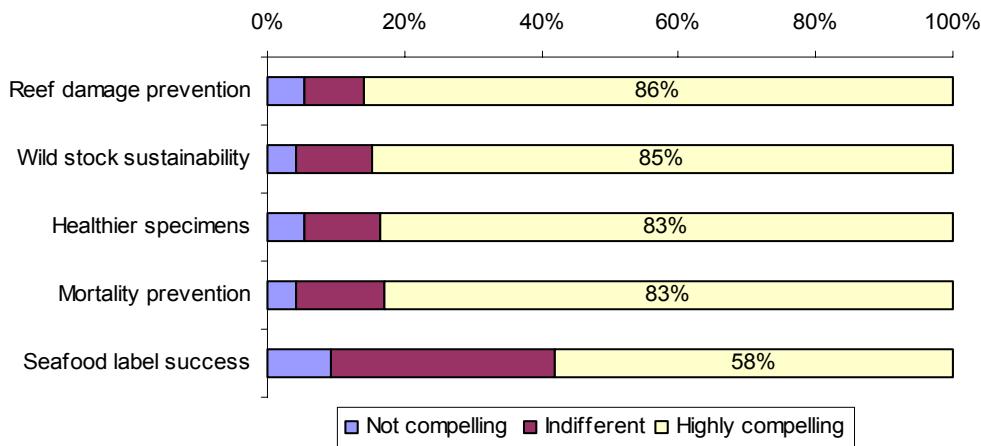


Figure 4-7. Distribution of responses regarding the importance of reasons to buy a MAC certified fish ( $n \geq 539$ )

Other interesting findings include the relationships between associating coral reef protection and wild stock sustainability with a MAC certified fish and the level of familiarity with the MAC program (Figures 4-8 and 4-9, respectively). Participants that were only somewhat familiar with the MAC program were most likely to associate coral reef protection and sustainability of wild stocks with MAC certification. These observations indicate that, although most participants associate protection of reefs and wild stocks with the MAC ecolabel, respondents who are most familiar with the MAC certification program have a reduced perception that the program is effective in addressing these two considerations.

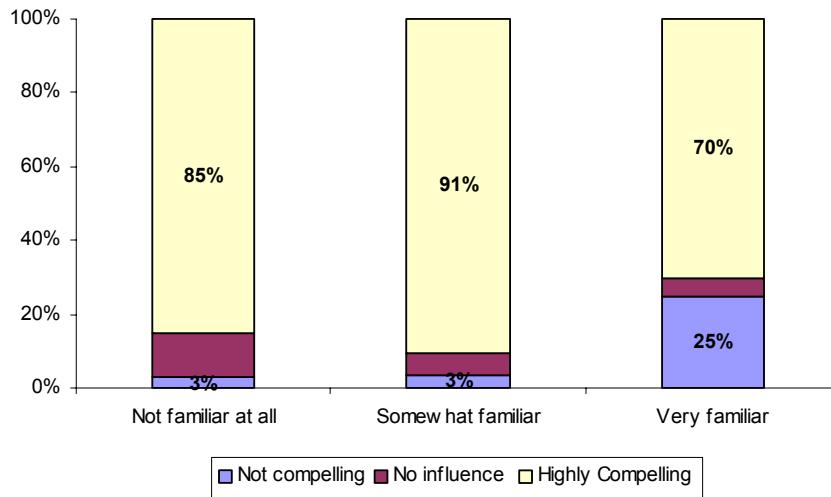


Figure 4-8. Association of coral reef protection with MAC certification by MAC familiarity level, on average across respondents (n = 541)

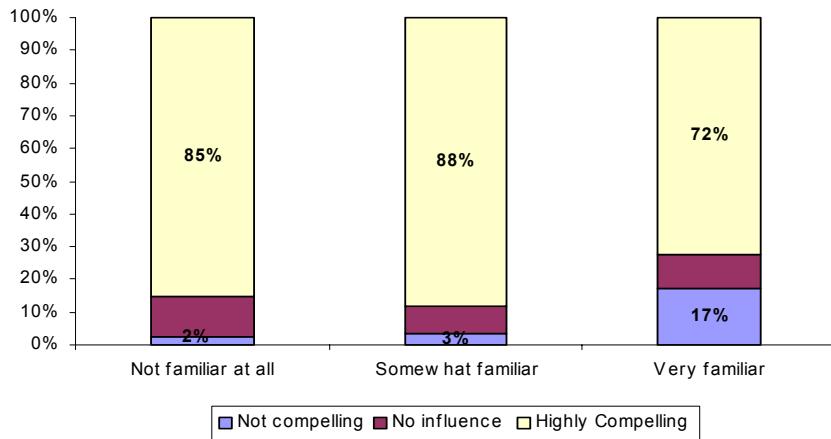


Figure 4-9. Association of wild stock sustainability with MAC certification by MAC familiarity level, on average across respondents (n = 541)

Participants were asked to rate the market potential of several techniques for producing unique marine ornamentals (Figure 4-10). Although data indicate an above average level of sophistication for respondents, these results indicate preferences for traditional production methods. Around 70% of respondents viewed improved diets as having the highest potential to produce marketable marine ornamentals. Around the same share of respondents ranked selective breeding as having a positive potential. In

contrast, innovative techniques, such as the use of hormones and genetic modification, were considered to have a positive market potential by only 9% and 13% of respondents, respectively.

Although the majority of respondents (67%) viewed genetically modified specimens as having little market potential, 50% of them said they would be somewhat likely to purchase such specimens. However, the question about likelihood of purchase used the word “transgenic”, so it is possible that respondents do not really know what this expression means. About 27% of respondents were not likely to purchase transgenic fish, 18% were very likely to do so and around 5% claimed they were undecided.

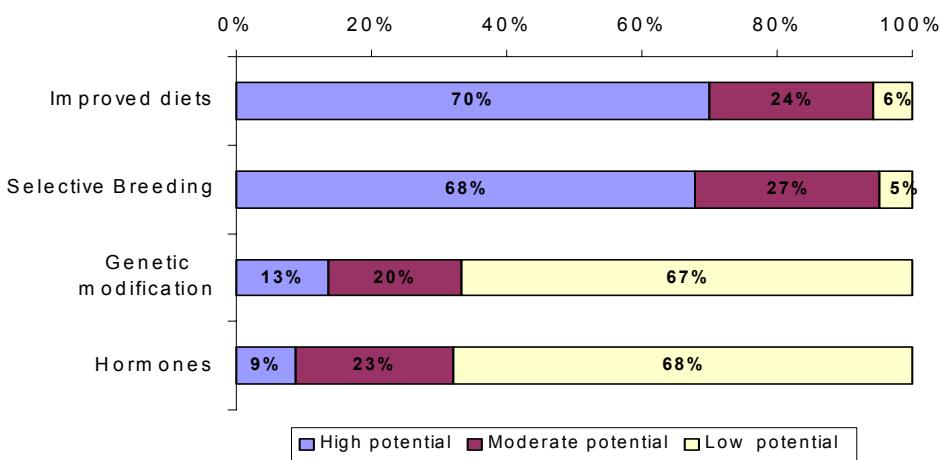


Figure 4-10. The perceived market potential of alternative production techniques that can be used to produce unique marine ornamental species by respondents ( $n \geq 541$ )

Respondents have homogeneous demographics especially in regards to sex, age, education and income levels. The majority of respondents were males (i.e., 90%). Most can be characterized as young or middle-aged individuals as 72% were born between 1960 and 1979. Overall, 39% of respondents were between 24 and 34 years old, 33%

were between 34 and 44, 19% were older than 44. Only 10% were younger than 24 (Figure 4-11).

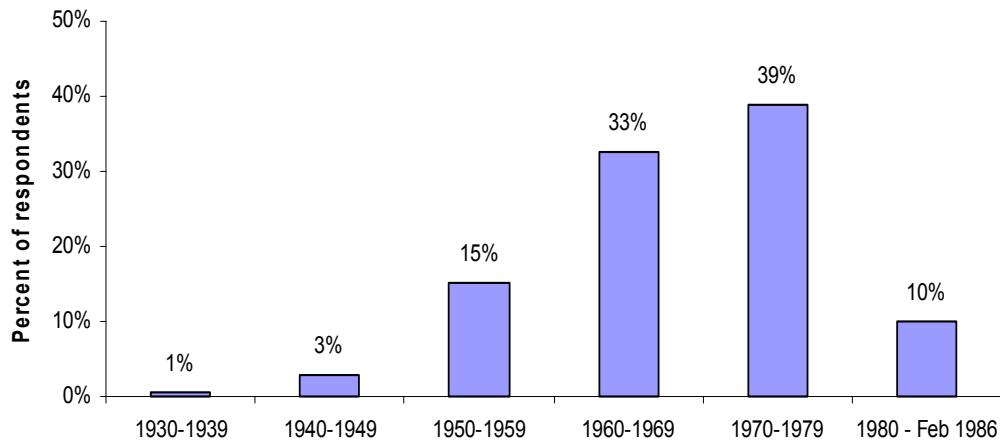


Figure 4-11. Distribution of year of birth of respondents (n = 546)

About 66% of respondents had some college or a college degree and an additional 24% had some graduate school training (Figure 4-12). Respondents also tended to have high-income levels. About 43% of participants had annual household incomes (before taxes) between \$50,001 and \$100,000, and 35% of respondents had household incomes of more than \$100,000 per year (Figure 4-13).

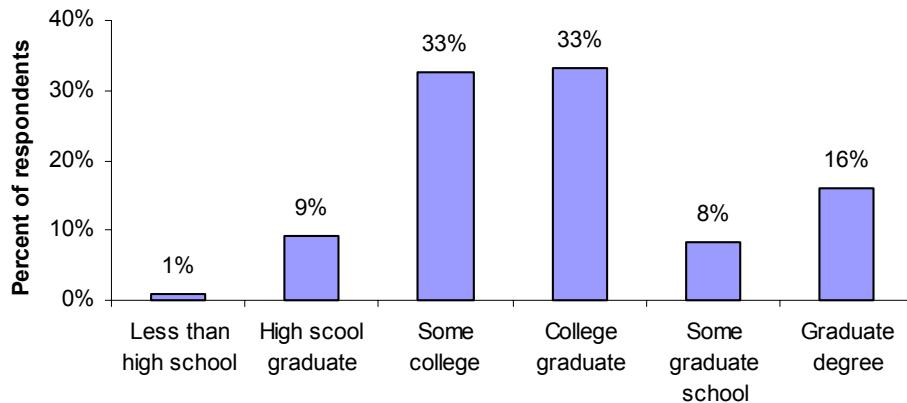


Figure 4-12. Distribution of the highest level of education of respondents (n = 538)

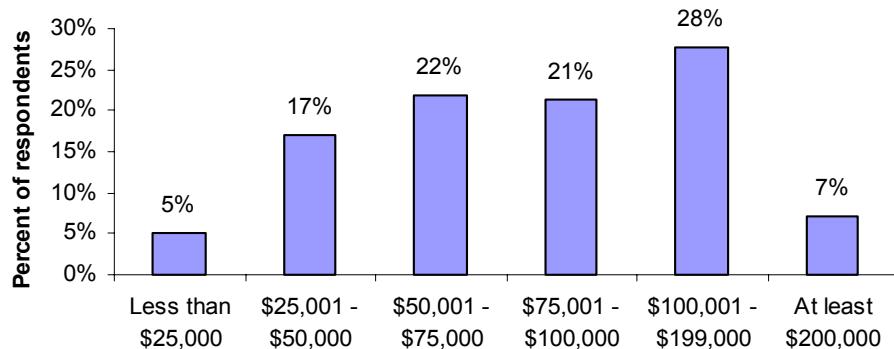


Figure 4-13. Distribution of annual gross income of respondents (n = 537)

In terms of geographic distribution, 90% of the surveys came from hobbyists currently living in the United States (Figure 4-14A). Around 7.5% of the remaining participants reside in Canada and 2.5% were from Mexico and other countries. Within the U.S., 54% of participants reside in the Northeast and the Great Lakes regions, 34% came from the Southeast (including Puerto Rico) and the Pacific (including Hawaii), and 12% came from Alaska, the Southwest and the Mountain-Prairie regions (Figure 4-14B).

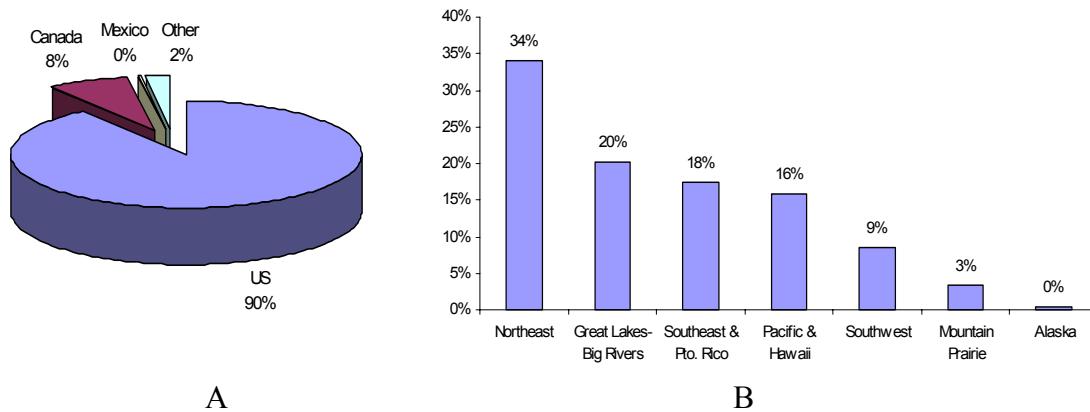


Figure 4-14. Geographic distribution of respondents by region (A) and within the United States (B).

Respondents live in large small communities (Figure 4-15). About 40% live in communities with more than 500,000 inhabitants and 39% reside in areas with less than 100,000 inhabitants. In total, 21% of respondents reside in communities of between 100,001 and 500,000 people.

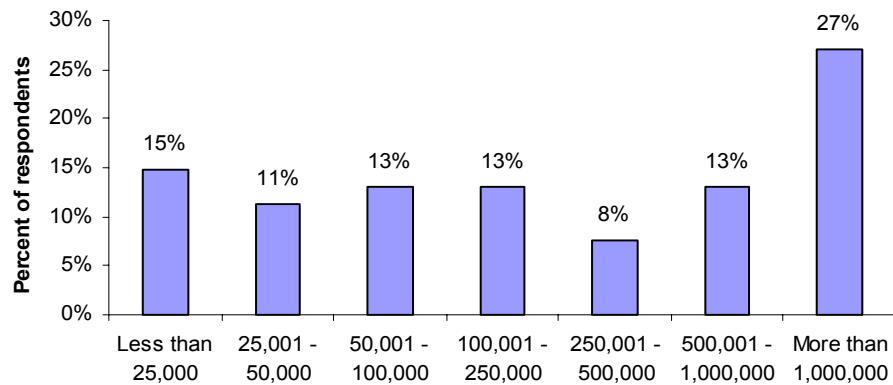


Figure 4-15. Distribution of respondents by size of the communities where they reside (n = 541)

According to the responses, the hobbyists surveyed in this research represent a homogeneous segment of the market. They are relatively young, and highly interested in the hobby. They are aware of, and give considerable importance to, protection of coral reefs and wild stocks. They have limited familiarity with the MAC certification program and above average levels of education and income. All these characteristics play an important role in the framework for analyzing purchase behavior

Before respondents were presented with the choices, they were asked to rate their level of familiarity with both species on a scale ranging from not at all familiar to very familiar. The majority of respondents had limited familiarity with the blue-faced angelfish, with 49% being somewhat familiar and 33% being not at all familiar (Table 4-1). On the other hand, the majority of respondents (i.e., 65%) were very familiar with the maroon clownfish and less than 2% knew nothing about it (Table 4-1).

Table 4-1. Respondent familiarity with fish species used in market experiments

Fish familiarity level	Blue-faced angelfish	Maroon clownfish
Not at all	33.03%	1.29%
Somewhat	49.26%	33.70%
Very	17.71%	65.01%

n = 542 for blue-faced angelfish and 543 for maroon clownfish.

The rate of non-response for any choice set in the two exercises was never higher than 2% (Table 4-2). In terms of measuring indirect utility, this result shows that only a small percentage of respondents did not derive any utility from the attributes and attribute levels presented. Therefore, the lack of a no-choice option probably did not distort estimates of preferences for this group of hobbyists.

Table 4-2. Distribution of responses by species and choice set

Species	Set	N	Choice		No-choice
			Alternative 1	Alternative 2	
Angelfish	1	546	F 68.68%	J 30.59%	0.73%
Angelfish	2	546	J 30.95%	H 68.13%	0.91%
Angelfish	3	546	H 63.37%	F 36.08%	0.55%
Angelfish	4	546	M 55.86%	J 43.41%	0.73%
Angelfish	5	546	H 57.33%	M 41.94%	0.73%
Angelfish	6	546	M 60.26%	F 39.01%	0.73%
Clownfish	1a	339	P 2.36%	T 96.76%	0.88%
Clownfish	1b	207	Q 95.17%	U 4.35%	0.48%
Clownfish	2	546	T 50.73%	N 48.17%	1.10%
Clownfish	3a	339	N 95.58%	P 3.83%	0.59%
Clownfish	3b	207	G 16.43%	Q 83.09%	0.48%
Clownfish	4a	339	R 9.73%	T 89.97%	0.29%
Clownfish	4b	207	S 88.89%	U 9.18%	1.93%
Clownfish	5a	339	N 93.81%	R 5.01%	1.18%
Clownfish	5b	207	G 8.20%	S 91.30%	0.50%
Clownfish	6	546	R 76.00%	P 23.00%	1.00%

One salient fact is, in comparison to the blue-faced angelfish experiment, the distribution of responses for the hypothetical clownfish show a strong bias towards alternatives featuring a tank-bred alternative. Since this one attribute dominated choices for 80% to 90% of respondents in this experiment, the effects of the remaining attributes

could be confounded with the effect of the tank attribute. Therefore, the modeling and analysis for this experiment will need to take this situation into account.

Choice observations for both experiments were modeled through binary probit specifications, using a maximum likelihood approach. Data were analyzed using TSP (Time Series Processor) statistical software version 4.4.

### **Maroon Clownfish Results**

Two choice observations coded as 1 and 0 from each of the 546 respondents to the six-paired choice sets were obtained. Therefore, a total of 6,552 observations were computed and analyzed for this experiment.

### **Model Specification**

First, a basic pooled probit model representing only the main effects and interactions of the 3 attributes used in this experiment (i.e., certification status, source and price) was defined. Interactions among attributes were introduced to capture the conditional effects of price and certification status given the presence or absence of the dominant attribute.

After accounting for effects of attributes exclusively, selected characteristics of the respondents were introduced into the basic model in the form of interactions with the certification attribute in order to capture potential preference heterogeneity with respect to certification (Bennett and Blamey 2001). Such interactions would indicate how these characteristics modify the estimated effect of MAC certification on preferences for marine ornamental fish. Dummy variables indicating attitudes, such as if the respondent was at least somewhat familiar with the MAC certification program, at least somewhat familiar with the featured species or considered prevention of coral reef damage and overfishing as important reasons to buy certified fish, were also introduced into the

model. Additional dummy variables were used for income, age, geographic regions and education.<sup>3</sup>

Since the total data set consists of a series of observations from each respondent and to further account for heterogeneity, a test of random effects usually implemented in panel data with dichotomous dependent variables was conducted. With this procedure, the stochastic component (i.e., error term) of the indirect consumer utility consists of the traditional error term associated with each observation in the data set and an additional term capturing any potential variation across individual respondents (Kennedy 1994). Since the correlation between individuals and the error term was not statistically significant, this document reports the results of the pooled probit model, where any preference heterogeneity is captured by the demographic-based interaction variables (Table 4-3).

According to economic theory, the effect of price on purchase decisions was expected to be negative. However, due to the luxury nature of the product examined (i.e., saltwater aquarium keeping) that negative effect was not expected to be large. It was also hypothesized that MAC environmental certification would have a positive effect on the utility consumers obtain from buying a saltwater ornamental fish, because of the widely known concerns about damage to coral reefs and overfishing associated with collection in the wild. Due to these concerns, it was expected that collection from the wild as a source would have a negative effect on purchase decisions and tank-raising would exhibit a positive influence on choices.

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<sup>3</sup> Alternative specifications expanding the basic model by the inclusion of just respondents' attitudes interacting with certification and the further inclusion of respondents' characteristics without interactions were also considered. Likelihood ratio tests indicated that the chosen model had the best goodness of fit.

Table 4-3. Definition of probit model explanatory variables for maroon clownfish choice analysis<sup>a</sup>

Parameter	Description
C	Constant
PRICE	\$21.99; \$24.99; \$27.99
CERT	0 if the fish is not MAC certified, 1 if the fish is MAC certified
TANK	0 if the fish is wild-caught, 1 if the fish is tank-raised
PRCR	Interaction between price and certification levels
PRTK	Interaction between price and type of fish source
CRTK	Interaction between certification levels and type of fish source
CRTKPR	Interaction between price, certification levels and type of fish source
MCFAMI	1 if respondent was familiar with clownfish and the fish offered was certified, 0 otherwise
MACFAMI	1 if respondent was familiar with the MAC certification program and the fish offered was certified, 0 otherwise
RFCOMPI	1 if respondent considered that coral reef damage prevention was an important reason to buy a certified fish and the fish offered was certified, 0 otherwise
FHCOMPI	1 if respondent considered that wild stock protection was an important reason to buy a certified fish and the fish offered was certified, 0 otherwise
AGE2I	1 if respondent was 24-34 years old and the fish offered was certified, 0 otherwise
AGE3I	1 if respondent was 34-44 years old and the fish offered was certified, 0 otherwise
AGE4I	1 if respondent was over 44 years old and the fish offered was certified, 0 otherwise
PACIFI	1 if respondent was from the U.S. Pacific region and the fish offered was certified, 0 otherwise
SEI	1 if respondent was from the U.S. Southeast region and the fish offered was certified, 0 otherwise
LAKENEI	1 if respondent was from the U.S. Northeast or Great Lakes region and the fish offered was certified, 0 otherwise
SWMTALI	1 if respondent was from the U.S. Southwest or Mountain Prairie or Alaska region and the fish offered was certified, 0 otherwise
DEDUCI	1 if respondent was at least a high school graduate and the fish offered was certified, 0 otherwise
INCOM2I	1 if the annual income level of respondent was between \$25,000 and \$50,000 and the fish offered was certified, 0 otherwise
INCOM3I	1 if the annual income level of respondent was between \$50,001 and \$75,000 and the fish offered was certified, 0 otherwise
INCOM4I	1 if the annual income level of respondent was higher than \$75,000 and the fish offered was certified, 0 otherwise

<sup>a</sup> See Appendix B for summary of descriptive statistics of the variables.

However, the negative effect of wild-caught as a source was expected to be influenced by certification status. Since most of the unique, colorful fish sought by hobbyists are currently collected from the wild, it was hypothesized that the presence of certification could reduce the negative effect. This expectation is supported by the premise that this hobby is a luxury activity, and therefore, the more unique and diverse the good, the more utility consumers obtain from it.

It was also expected that respondents indicating at least some level of familiarity with the MAC program and those associating marine ecosystem protection and wild stock sustainability with the MAC ecolabel would display a positive preference for certification. Since about 95% of respondents were familiar with the fish and it is increasingly available from aquaculture, a high level of fish familiarity could be expected to limit the positive influence of certification. The hypothesized limited effect of certification in this case is based on the fact that to date the MAC certification program does not apply to cultured specimens and respondents could not see a relationship between the two attributes as a feasible option.

It was expected that respondents living in U.S. regions affected by the commercial collection industry (i.e., revenues support local communities), such as in the Pacific and Southeast, would show a positive preference for certification. In addition, higher age and education levels were hypothesized to lead to a positive effect on preferences for certification since higher sensitivity for environmental protection is likely to exist among increasingly educated and beyond middle-age individuals. Finally, respondents with high incomes were expected to exhibit a positive preference for certified fish because of their ability to afford a premium for MAC ecolabelled specimens.

## Model Estimates

Both the basic and expanded models explain the relationship between dependent and independent variables better than the model with only an intercept, as the LR statistics for zero slopes indicate (Table 4-4).

Table 4-4. Probit model estimates for maroon clownfish

Variable	Model 1		Model 2	
	Estimate	t- value	Estimate	t- value
C	-3.86	***	-4.51	-3.86
PRICE	0.10	**	3.07	0.10
CERT	-4.36	***	-3.72	-5.48
TANK	0.26		0.24	0.26
PRCR	0.17	***	3.84	0.19
PRTK	0.08	*	1.84	0.08
CRTK	3.22	**	2.05	3.46
CRTKPR	-0.15	**	-2.44	-0.15
MCFAMI				0.08
MACFAMI				0.08
RFCOMPI				0.21
FHCOMPI				0.23
AGE2I				0.04
AGE3I				0.07
AGE4I				0.08
PACIFI				-0.06
SEI				-0.16
LAKENEI				-0.12
SWMTALI				-0.14
DEDUCI				-0.09
INCOM2I				0.18
INCOM3I				0.14
INCOM4I				0.16
N	6552		6402	
LogL	-3195.27		-3071.27	
LR (intercept only)	2691.94		2731.66	
R2	0.36		0.38	
Correct predictions	78.49%		78.75%	

\*\*\* Statistically significant at the 1% confidence level.

\*\* Statistically significant at the 5% confidence level.

\* Statistically significant at the 10% confidence level.

For the basic model (model 1) where only the effects of the attributes are assumed to influence consumers' utility from choice decisions, 7 of the 8 coefficients are statistically significant (i.e., different from zero) at the 10% confidence level. The effect of the TANK variable (the only one not statistically significant) is; however, captured with the 2-way and 3-way interaction terms in the model, which were statistically significant.<sup>4</sup> Therefore, looking only at the coefficient of tank will lead to an incorrect interpretation of the effect of the tank-bred attribute. In general, given this model specification, coefficients of the interacted variables complement each other and need to be considered in that way in order to obtain a comprehensive interpretation of attributes' influence on consumer's utility.

As suggested by the distribution of choices across choice sets, estimates show that tank-bred has a positive impact on the utility derived by the hobbyist from the purchase of such fish. Moreover, if the fish offered to the respondent is certified (i.e., ecolabelled), tank-bred increases utility even more (i.e., the coefficient of CRTK is positive and statistically significant).

Contrary to expectations, MAC certification as a characteristic of wild-caught fish appears to influence purchase decisions in a significantly negative way. The positive coefficient of the interaction between source and certification shows that if the fish is tank-bred the effect of ecolabeling on respondents' utility and purchase decisions would remain negative, but at a much lower level (*ceteris paribus*). This result suggests that this specific group of hobbyists has a negative perception of the MAC certification program and that an ecolabel is not a compelling factor in purchase decisions. Open comments

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<sup>4</sup> Likelihood ratio tests were used to examine whether the interaction terms improved the explanatory fit of the model.

from respondents collected at the end of the survey instrument provide some support for this interpretation. About 6% respondents strongly stated their lack of faith in the MAC program and a preference for tank-bred and raised fish as a means to avoid damage caused by capturing wild fish (Appendix C).

One interesting and unexpected finding for these avid hobbyists is that higher prices appear to increase the utility derived from buying a fish. This result is indicated by the positive coefficient of the main effect (PRICE). The positive estimates from the two-way interaction terms show that consumers would continue to increase their utility regardless of price if the fish is wild-caught and certified or only tank-bred. However, if a fish is certified and also tank-bred, incremental changes in price would negatively affect consumers' purchase decisions (i.e., reduce the probability that the fish would be purchased), as the negative coefficient of the three-way interaction term reflects.

According to these results, price did not appear to be an important factor when deciding to choose a fish, but its effects were conditional on the source and certification status of a fish. This particular situation could be related to the profile of this specific segment of respondents. Descriptive statistics showed that the majority of them have above average annual incomes and already paid more than \$75 for a single fish.

After introducing interaction terms to capture the effects of demographics on preferences for certified (ecolabelled) fish, the estimated attribute effects remained the same. Results from model 2 show that only a few interactions had statistically significant influences on certification preferences. The level of familiarity with the MAC ecolabeling program (MACFAMI) and whether the respondent believed the program

could prevent reef damage and overfishing (RFCOMPI and FHCOMPI, respectively) were the only three factors that were found to affect certification-related preferences.

The positive coefficient of the variable MACFAMI indicated that respondents who were at least somewhat familiar with the MAC program had higher preferences for a certified fish than those who were not at all familiar with the MAC ecolabel. Likewise, the positive signs of RFCOMPI and FHCOMPI suggest that hobbyists who related reef ecosystem and stock protection to the MAC ecolabel had higher preferences for a certified fish. Moreover, estimates also indicated that the positive impacts of protecting both coral reefs and wild stocks on preferences for the MAC ecolabel are of similar importance.

As t-tests of statistical significance showed, and contrary to initial hypotheses, higher incomes and education levels, along with being from a geographic region that directly benefits from a collection industry were not found to influence preferences for the MAC ecolabel for this segment of hobbyists.

### **Estimating Effects on Probability of Purchase**

#### **Attributes effects**

The relationships described so far correspond to the effects of attributes on the latent indirect utility function of the homogeneous group of avid saltwater aquarium hobbyists. To illustrate the effects of the attributes on the probability of purchasing a fish, the estimated probit model was used in simulations where only the attribute levels were systematically changed to isolate effects. To this end, a constant “base” product was defined. The base price level was set at its mean, (i.e., \$24.99), while certification and source were set at zero to reflect an uncertified, wild-caught fish. The dummy variables for familiarity with the fish and attitudes toward protection of reefs and wild

stocks were set equal to one, reflecting the average profile of respondents (i.e., the majority were at least somewhat familiar with the maroon clownfish and considered reef and wild stock protection as compelling reasons for buying a MAC-certified fish). The remaining variables were set equal to zero implying that the “base” respondent did not reside in the U.S., was not familiar with the MAC ecolabeling program, had only a high school (secondary) education, earned less than \$25,000 annually, and was from 18-24 years old. Using this base, product and hobbyists simulations identify the change in the probability that a hobbyist would purchase the fish for each level of the statistically significant variables, while keeping the remaining variables at the base level.

The probability of purchasing a maroon clownfish would overwhelmingly increase if fish were tank-bred, regardless of certification status (Figure 16). The probability of purchase increases from 12% to 89% for an uncertified fish and from 11% to 75% for certified (ecolabelled) fish.

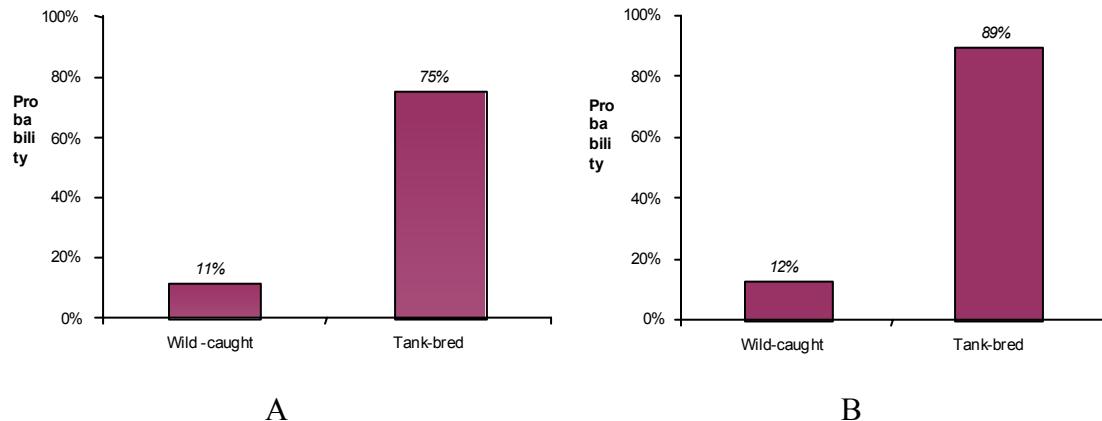


Figure 4-16. Probability that the base hobbyist would buy a maroon clownfish by source.  
A) Certified fish. B) Uncertified fish.

Contrary to expectations, results indicate that the ecolabel reduces the probability of purchase for both levels of fish source, when price and other factors are kept constant (Figure 4-17). However, the magnitude of the negative effect is much lower if the fish is

wild-caught (from 12% to 11% versus from 89% to 75% for a tank-bred maroon clownfish). Overall, the highest probability of purchase was associated with an uncertified tank-bred fish.

These results suggest that the MAC certification ecolabel is believed to improve the environmental consequences of wild-caught collection activities by this particular group of hobbyists. Moreover, these hobbyists would be more likely to buy an uncertified maroon clownfish at the same price. Such an unexpected outcome is explained by respondent comments. According to these comments (which are summarized in Appendix C) and the simulations, it can be inferred that respondents have more confidence in using culturing techniques as a replacement for wild-caught sources to minimize coral reef damage and overfishing concerns associated with this hobby. In terms of wild-caught fish, the estimated reduction in the probability of purchase is very small, but the absence of a significant positive effect of certification strongly suggests a lack of confidence in the effectiveness of the MAC ecolabel to ecosystems.

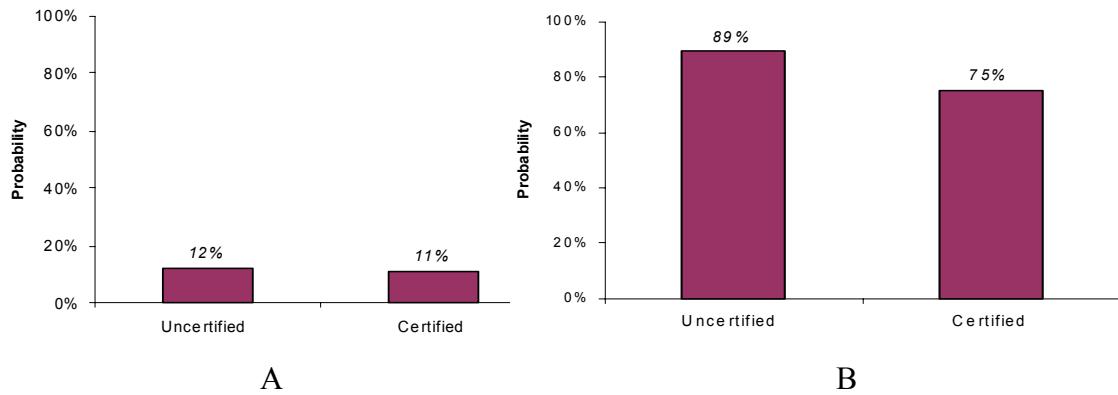


Figure 4-17. Probability that the base hobbyist would purchase a maroon clownfish by certification status. A) Wild-caught fish. B) Tank-bred fish.

The positive relationship between price and the latent indirect utility function indicates that the probability of purchasing a maroon clownfish increases with prices, but

varies depending on the certification status and source (Figure 4-18). Since the experimental design only offered certified fish at higher prices, this result could be reflecting an underlying preference for ecolabelled maroon clownfish.

For a wild-caught maroon clownfish, changes in the probability that the “base” hobbyist would purchase the fish increased with price but differed considerably based on certification status. Respondents were more likely to purchase a certified clownfish at every price level but the probability increased at higher prices; the likelihood of purchase reached 38% for a certified (ecolabelled) maroon clownfish at \$3 above the average (i.e., 24.99), which only represents a 12% price increase. For a tank-bred maroon clownfish, the probability of purchase increases with price but at a diminishing rate. Over the range of prices considered, the probability of purchase increases as much as 16 percentage points for a certified maroon clownfish (i.e., from 75% to 91%).

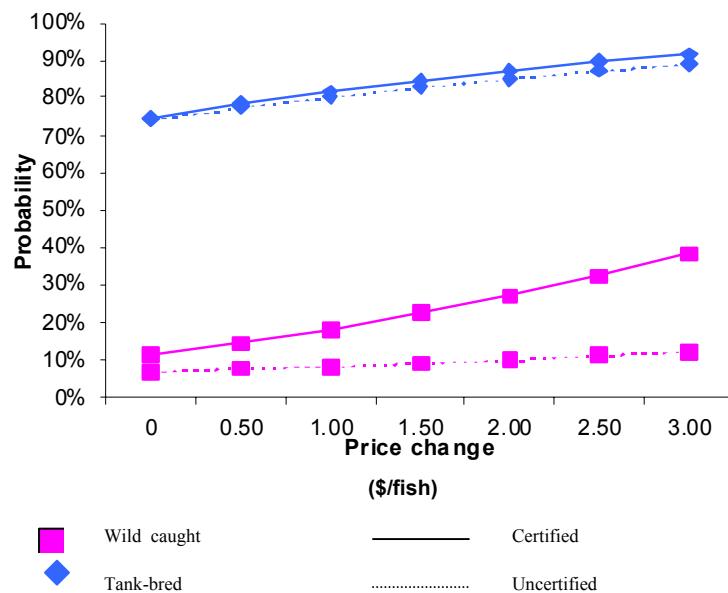


Figure 4-18. Probability that the base hobbyist would purchase a maroon clownfish by price, certification status, and source

The results suggest that respondents would be likely to pay a premium for a wild-caught ecolabelled maroon clownfish in order to obtain an indication of ecosystem protection. Respondents also seem more willing to buy a tank-bred maroon clownfish at any reasonable price because of the implied relative environmental benefits. However, results suggest respondents are not willing to pay a premium for an ecolabel (i.e., environmental protection) if the maroon clownfish is tank-bred.

### **Influence of attitudes on certification preferences**

The influence of hobbyist characteristics on preferences for certification was measured through simulations of the statistically significant characteristics with respect to base conditions as was done previously. As the MAC certification program currently applies only to wild-caught fish, the analysis does not consider effects for tank-bred fish. Results show that increasing the level of knowledge respondents have about the MAC certification program increases the probability that the base hobbyist will buy a certified maroon clownfish from 11% to 13% (Figure 4-19).<sup>5</sup>

If respondents indicated that coral reef damage prevention was not a compelling reason to buy a certified fish, their likelihood of purchasing a certified maroon clownfish fell from 11% to 8% (Figure 4-19). Likewise, if respondents indicated that protection of wild stocks was not a compelling reason to purchase a MAC-certified fish, their probability of buying an ecolabelled maroon clownfish fell from 11% to 7% (Figure 4-19). Thus, prevention of overfish stocks had an equal effect as protection of coral reef habitats to those buying a certified fish. This observation reinforces the ecosystem-

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<sup>5</sup> Although this analysis does not separate respondents who were somewhat familiar from those who were very familiar, the estimated positive effect of “familiarity” on preferences for certified fish depended on those hobbyists that were only somewhat familiar with the MAC program. Further analysis differentiating the effects of these levels of familiarity would be useful to clarify the observed differences in preferences for a MAC ecolabelled maroon clownfish.

friendly preference of the hobbyists surveyed in this study. However, these effects are relatively small given the overall probability of purchase (i.e., an 11% base). Recall that these respondents are much more likely to buy tank-bred species to ensure ecosystem protection than to rely on the effectiveness of the MAC certification program. Currently, the main focus of the MAC has been protection of reef ecosystems, but an effort to increase the reliability and effectiveness of the MAC program's ability to efficiently provide not only protection for coral reefs protection but also protection for fish stocks could yield benefits in terms of increasing the probability of purchase.

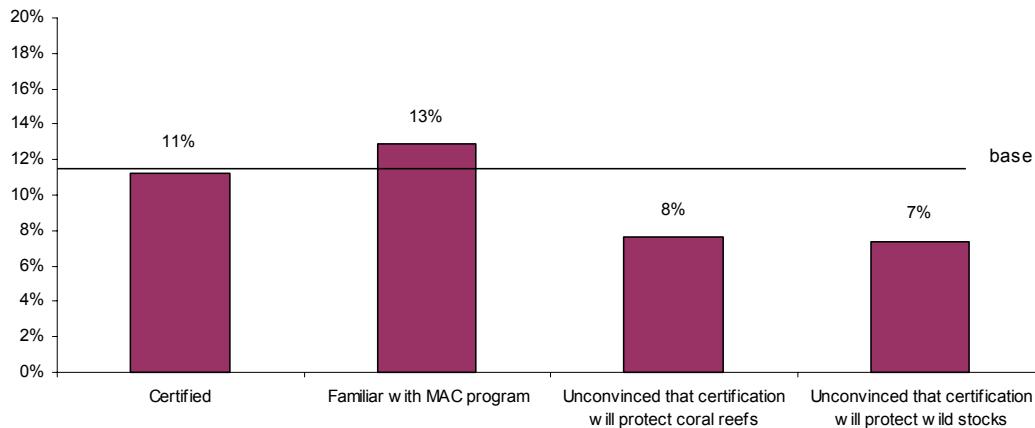


Figure 4-19. Probability that the base hobbyist would purchase a certified wild-caught maroon clownfish by respondent familiarity with MAC and beliefs regarding its effectiveness

Considering all these results, it is concluded that education efforts focusing on increased public knowledge of the program's purpose, scope of action and proof of effectiveness in preventing damage to marine ecosystems and fish stocks would likely improve preferences for ecolabelled maroon clownfish to this segment of hobbyists.

## Blue-Faced Angelfish Results

### **Model Specification**

The blue-faced angelfish experiments examined the effects of certification status, length of survival guarantee, and price characteristics of the fish, in addition to the respondent characteristics and beliefs examined for the maroon clownfish.

Four probit models were specified to analyze the choice behavior observed from the experiments:

Model 1 measured the likelihood that a hobbyist would pay a 15%-17% premium for a certified fish and how that likelihood would change with an extended survival guarantee and significant individual characteristics. Model 2 measured the likelihood that a hobbyist would pay a 15%-17% premium for an extended survival guarantee and how that likelihood would change with MAC certification status. Model 3 measured the likelihood of purchasing a wild-caught blue-faced angelfish from Indonesia and how that likelihood would change with an extended survival guarantee, assuming constant prices. Model 4 measured the likelihood that a hobbyist would pay for both certification and an extended survival guarantee.

Models 1 and 2 included applicable fish attributes and respondents' characteristics as explanatory variables. Models 3 and 4 included the respondent characteristics as explanatory variables since all the fish attributes were used to define the dependent variable. This analysis is different than the one presented in the previous section since the variation among attribute levels designed for this experiment was limited, in comparison to the maroon clownfish experiment. Two observations from each respondent were used for models 1 and 2 (i.e., 1,092 in each model), while only one observation was used for models 3 and 4 (i.e., 546 in each model).

The explanatory variables used in models 1-4 are summarized in Table 4-5.<sup>6</sup> The same hypotheses described in the maroon clownfish analysis were applied to the blue-faced angelfish results.

Table 4-5. Definition of probit model explanatory variables for the blue-faced angelfish choice analysis

Parameter	Description <sup>a</sup>
C	Constant
CERT	0 if the fish is not MAC certified, 1 if the fish is MAC certified
GUAR	0 if the fish has a 5-day survival guarantee, 1 if the fish has a 14-day survival guarantee
BAFAMI	1 if respondent was familiar with the Blue-faced angelfish and the fish offered was certified, 0 otherwise
MACFAMI	1 if respondent was familiar with the MAC certification program and the fish offered was certified, 0 otherwise
RFCOMPI	1 if respondent considered that coral reef damage prevention was an important reason to buy a certified fish and the fish offered was certified, 0 otherwise
FHCOMPI	1 if respondent considered that wild stock protection was an important reason to buy a certified fish and the fish offered was certified, 0 otherwise
AGE2I	1 if respondent was 24-34 years old and the fish offered was certified, 0 otherwise
AGE3I	1 if respondent was 34- 44 years old and the fish offered was certified, 0 otherwise
AGE4I	1 if respondent was over 44 years old and the fish offered was certified, 0 otherwise
PACIFI	1 if respondent was from the U.S. Pacific region and the fish offered was certified, 0 otherwise
SEI	1 if respondent was from the U.S. Southeast region and the fish offered was certified, 0 otherwise
LAKENEI	1 if respondent was from the U.S. Northeast or Great Lakes region and the fish offered was certified, 0 otherwise
SWMTALI	1 if respondent was from the U.S. Southwest or Mountain Prairie or Alaska region and the fish offered was certified, 0 otherwise
DEDUCI	1 if respondent was at least a high school graduate the fish offered was certified, 0 otherwise
INCOM2I	1 if the annual income level of respondent was between \$25,000 and \$50,000 and the fish offered was certified, 0 otherwise
INCOM3I	1 if the annual income level of respondent was between \$50,001 and \$75,000 and the fish offered was certified, 0 otherwise
INCOM4I	1 if the annual income level of respondent was higher than \$75,000 and the fish offered was certified, 0 otherwise

<sup>a</sup>See Appendix B for summary of descriptive statistics of the variables.

<sup>6</sup>As in the previous experiment, alternative specifications expanded the basic model by including respondents' attitudes in an interaction with certification. A likelihood ratio test supported the selection of this specification. In addition, for models 1, 2 and 4, the interactions among respondents' characteristics and certification are the same as including the characteristics as a main effect because the fish was assumed to be certified.

## Model Estimates

All four models of consumers' indirect utility adequately explain the relationship between dependent and independent variables better than the model with only an intercept, as the LR statistics for zero slopes indicate (Table 4-6).<sup>7</sup> Overall, familiarity with the species was never statistically significant, indicating that it has no effect on the probability that a blue-faced angelfish will be purchased. This suggests that hobbyists do not seek a specific species to buy.

The variable representing the length of survival guarantee in model 1 is associated with a negative coefficient that is significantly different from zero at the 1% confidence level (Table 4-6). Contrary to expectations, this indicates that the extent of a survival guarantee can have a negative influence on the preference for a certified fish. In other words, if a certified fish were offered with an additional 9 days of survival guarantee (i.e., 14 days), consumers would reduce their willingness to pay a 15%-17% premium. This result suggests an association between the physical condition of a blue-faced angelfish and certification. Respondents appear to perceive the MAC ecolabel as already providing a healthier fish, as such the ecolabel may be considered a substitute for a longer survival guarantee.

Results also show that respondent characteristics, such as familiarity with the MAC program, confidence that the MAC ecolabel can provide ecosystem protection, location of residence, income and age also affect consumers' choices (Table 4-6).

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<sup>7</sup> Attribute-only specifications were first estimated for models 1 and 2. As in the maroon clownfish analysis, those basic models were rejected via Likelihood ratio tests in lieu of the "expanded" models presented in Table 4-6.

Table 4-6. Probit model estimates for the blue-faced angelfish

Variable	Model 1		Model 2		Model 3		Model 4	
	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
C	-1.36***	-4.52	0.49 ***	8.69	-1.07 ***	-2.63	-0.36	-0.86
CERT			-0.73 *	-1.81				
GUAR	-0.25 ***	-3.00						
BAFAMI	0.05	0.55	-0.04	-0.37	-0.05	-0.39	0.15	1.16
MACFAMI	0.65***	7.41	0.33 ***	2.81	0.33 ***	2.79	0.47 ***	3.96
RFCOMPI	0.82 ***	4.76	0.22	0.87	0.85 ***	3.50	0.83 ***	3.26
FHCOMPI	0.50***	2.97	0.32	1.27	0.21	0.89	0.21	0.87
AGE2I	0.12	0.79	-0.02	-0.13	-0.11	-0.51	0.06	0.28
AGE3I	0.13	0.87	-0.25	-1.18	-0.08	-0.36	0.14	0.67
AGE4I	0.38**	2.22	0.08	0.35	-0.03	-0.12	0.31	1.33
PACIFI	-0.42 **	-2.33	-0.04	-0.19	0.16	0.65	-0.49 **	-2.01
SEI	-0.38 **	-2.14	-0.24	-1.04	0.09	0.41	-0.35	-1.43
LAKENEI	-0.38 **	-2.40	-0.33 *	-1.65	-0.02	-0.11	-0.52 **	-2.47
SWMTALI	-0.42 **	-2.19	-0.56 **	-2.22	0.09	0.35	-0.51 **	-1.96
DEDUCI	0.23 *	1.65	0.06	0.33	0.05	0.24	0.02	0.08
INCOM2I	0.48 **	2.16	-0.13	-0.44	0.52 *	1.69	-0.35	-1.12
INCOM3I	0.49 **	2.19	-0.48	-1.61	0.56 *	1.82	-0.51	-1.62
INCOM4I	0.34	1.60	-0.30	-1.06	0.32	1.11	-0.45	-1.52
N	1040		1066		520		520	
LogL	-576.94		-673.89		-313.97		-324.03	
LR (intercept only )	203.60		116.90		52.51		66.31	
Scaled R2	0.19		0.10		0.09		0.12	
Correct predictions	71.82%		65.75%		69.23%		64.61%	

\*\*\* Statistically significant at the 1% confidence level.

\*\* Statistically significant at the 5% confidence level.

\* Statistically significant at the 10% confidence level.

As hypothesized, results show that those respondents who were at least somewhat familiar with the MAC program and/or that associated this program with effective coral reef and wild stock protection were more likely to buy a certified fish, as indicated by the statistically significant positive coefficients.

According to expectations, respondents over 44 years old with an annual income of between \$25,000 and \$75,000 were more likely to choose a certified blue-faced angelfish and pay 15%-17% premium (Table 4-6). Statistically significant coefficients for income indicate a similar effect on purchase behavior between the levels of \$25,000-\$50,000 and \$50,001-\$75,000, having the latest interval a slightly larger effect. Those who have at least a college education would also be more willing to pay for certification. Other categories for age and income levels were not statistically significant, and therefore, they are not interpreted.

Like the maroon clownfish experiment and contrary to what was expected, U.S. regions with a collection industry did not show preferences for certification (Table 4-6). Moreover, all geographic locations (which reflects U.S. regions) have negative and statistically significant impacts on the decision to pay a 15%-17% premium for a MAC certified fish. This implies that, in comparison to international hobbyists, respondents from the U.S. were less willing to pay a price premium for an ecolabelled blue-faced angelfish from Indonesia, even though the certification may indicate the fish should be healthier. In addition, estimates for each region show that the negative impact on certification preference is very similar among location categories.

Results for model 2 identify the factors influencing willingness to pay a 15%-17% premium for nine additional days of guaranteed survival. Contrary to the hypothesis, the

statistically significant negative sign of the coefficient for certification indicates that respondents were less likely to pay. This result further supports the hypothesis that an ecolabel and a survival guarantee are perceived as close substitutes in terms of the benefits to hobbyists.

Only few individual characteristics were observed to have statistically significant influences on the probability that an avid hobbyist would pay a premium for a blue-faced angelfish with an extended survival guarantee. As expected, the level of familiarity with the MAC certification program has a positive influence, as suggested by the reduction of the negative influence of certification status on preferences for a survival guarantee. Unexpectedly, beliefs with respect to the effectiveness of the ecolabel to protect reef and wild stocks did not significantly modify the effect of certification on preferences in this scenario. In addition, results show that the influence of certification status on preferences for an extended life warranty was even more negative for respondents from Alaska, central and northeastern U.S. regions. Contrary to the hypothesis, respondents from regions known to be directly involved with the marine ornamental industry did not show a significant preference for certification. Income, age and education did not influence the effect of certification status on purchasing decisions in this scenario.

Results for model 3 indicate that characteristics of respondents influenced preferences for certification more than did an extended a survival guarantee, at the same price. Again, the level of familiarity with the MAC program and association of the effective prevention of coral reef damage with the program have a positive impact on preferences for certification. This estimate reinforces the expected higher and positive influence of the perceived effective reef protection on preferences for MAC certification.

As expected, income has a positive effect on the preference for certification over a survival guarantee if price is kept constant. In addition, the coefficients associated with the income levels of \$25,000-\$50,000 and \$50,001-\$75,000 show a positive influence of those levels on purchase decisions for a certified fish. In this scenario, considering wild stock protection as a compelling reason to buy a certified wild-caught blue-faced angelfish was not a significant factor influencing consumer choices. Findings also show that the expected influences of age and geographic location on preferences for certification were not observed for these respondents in this scenario.

Model 4 reports the estimates of respondents' characteristics influencing the willingness to pay a 35% premium for both MAC certification and an extended survival guarantee for a wild-caught Indonesian blue-faced angelfish. According to expectations, variables indicating the level of familiarity with the MAC program and the association of effective coral reef protection with the MAC ecolabel show a positive influence on purchase decisions. However, the association of wild stock protection with the MAC ecolabel did not show any significant influence on preferences. Estimates for geographic location indicate that hobbyists from 3 U.S. regions, except those from the southeast, were less likely to pay a 35% premium for a certified blue-faced angelfish with an extended survival guarantee. The estimate for the southeast region was not statistically significant, and it indicates the absence of an observable influence on preferences with respect to this scenario. Age, education and income level did not have any significant effect on preferences for certification.

### **Estimating Effects on Probability of Purchase**

As in the previous experiment, estimates from the four probit models can be used in simulations to analyze the effect that changes in statistically significant explanatory

variables have on the probability of purchase in each scenario. To do so, independent variables were set at “base” values against which changes were measured. For this experiment, the base fixed all variables (i.e., dummies) at the zero level, except for variables indicating if respondents considered reef and wild stock protection as compelling reasons to buy a certified fish. Those two variables were set at a value of 1. The same base was used across models. In summary, the “base” hobbyist did not reside in the U.S., was not familiar with the MAC ecolabeling program, had only a high school (secondary) education, earned less than \$25,000 annually, and was from 18-24 years old.

Simulations for model 1 represent purchase probability levels for buying a certified wild-caught blue-faced angelfish from Indonesia at a 15%-17% premium. The probability of buying such fish at the base condition is 49% (Figure 4-20). In this case, the probability relates to purchasing a certified fish with only a five-day survival. An increase of nine additional days of warranty reduces the probability that respondents will pay the price premium for certification by over 20% (i.e., from 49% to 39%; Figure 4-20). This observation supports the idea that respondents perceive certification and survival guarantees as substitutes, especially for a high-value, wild-caught specimen like the blue-faced angelfish.

Familiarity with the MAC program has a considerable impact on probability of purchase. Respondents who were at least somewhat familiar with the certification program increased their likelihood to purchase the certified fish at the specified price premium by 25 percentage points (from 49% to 74%) or 51% (Figure 4-20).

Respondents who did not consider reef habitat and wild stock protection as compelling factors to buy a certified (ecolabelled) organism were less likely to pay a

price premium for certification, reducing the probability of purchase by 59% and 39% (to 20% and 30%) respectively, when compared to the base (Figure 4-20). These results also show that although both variables are important for respondents, reef protection was perceived as a more influential condition relative to certification than wild stock protection. This perception probably was supported by the fact that the fish was defined to be collected from the wild in Indonesia.

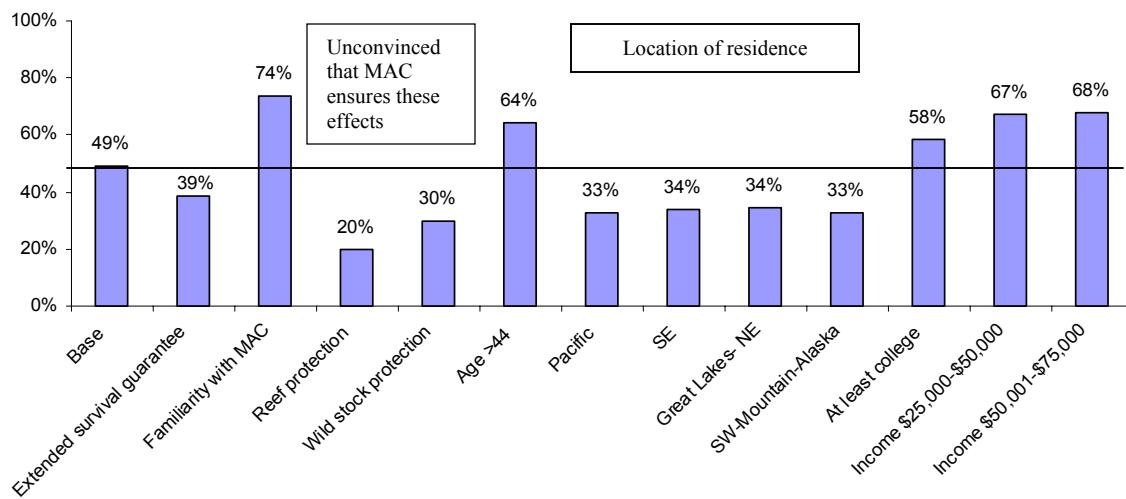


Figure 4-20. Probability that the base hobbyist would pay a 15%-17% premium for a certified wild-caught blue-faced angelfish from Indonesia by various fish and hobbyist attributes

In terms of the effects of socio-demographics, respondents from the U.S. were 30% less likely to pay the premiums for a certified fish that also had some level of life warranty (Figure 4-20). As indicated by estimates, this reduction is very similar for all U.S. regions, indicating no significant differences in purchase behavior across regions. Moreover, this outcome suggests that the value of MAC certification differs for American and international hobbyists. One explanation could be the existence of more

competition at the retail level in the U.S. Further research can explore and validate this or other underlying reasons for such differences.

Results indicate that in terms of age, only respondents older than 44 years showed a difference in purchase behavior (Figure 4-20). Such respondents increased the probability of purchase by 30%, *ceteris paribus* (i.e., from 49% to 64%). In addition, those who have attended college increased their likelihood to purchase by over 18% when compared to the base (i.e., from 49% to 58%).

With respect to income effects, only those respondents with annual income levels of between \$25,000 and \$75,000 affected probability of purchase (Figure 4-20). Those individuals with incomes between \$25,000 and \$50,000 increased their likelihood to purchase the specified fish by almost 37% (i.e., from 49% to 67%) and those with incomes ranging from \$50,001 to \$75,000 increased their likelihood to purchase by 39% (i.e., from 49% to 68%). This small difference suggests similar preferences across the two income levels.

Simulations for model 2 show the probability levels associated with the willingness to pay a 15%-17% premium for an extended life warranty for a fish with varying certification status (Figure 4-21). At the base, the probability of purchase for such a fish is 69%. This level corresponds to an uncertified fish. The presence of the MAC ecolabel reduces the likelihood to buy the specified fish in this scenario by over 10%, from 69% to 62% (Figure 4-21). This observation suggests that respondents perceive MAC certification, within the context of the experiment and the definition of the angelfish, as directly related to increasing the chance of survival and quality of the purchased fish.

If respondents were at least somewhat familiar with the MAC program, the presence of an ecolabel increased the probability of purchase by about 7% (5 percentage points) in comparison to the base (i.e., from 69% to 74%; Figure 4-21). This suggests that for these respondents, certification is perceived more as a complement to survival guarantee than as a substitute. The result also indicates an association between certification and issues beyond improving fish quality and chance of survival.

The negative impact of U.S. geographic location with respect to certification observed in the previously discussed model also appeared with model 2, although just for two regions (Figure 4-21). For this scenario, respondents from the Great Lakes and Big Rivers region would have a 29% lower likelihood of purchasing a certified blue-faced angelfish with extended survival guarantee (i.e., from 69% to 49%). Respondents from the Southwest, Mountain Prairie and Alaska regions showed an even larger reduction in probability to purchase. They would be about 42% less likely to pay for the extended life warranty in this situation. This observation suggests that these respondents focused on the implications of certification for fish quality more strongly than other individuals, which diminishes the role of the warranty attribute.

Note that given the same price increases for scenarios analyzed in models 1 and 2, the base probability of buying a fish offering only an extended survival guarantee was 59% higher than the base probability of purchasing a certified fish that offered a limited life warranty (figure 4-20 vs. figure 4-21). Such a situation suggests a somewhat stronger preference for life guarantees over certification as related to ensuring the quality of a high-value fish, whose supply may have harmful implications for the fish stocks and reef ecosystems.

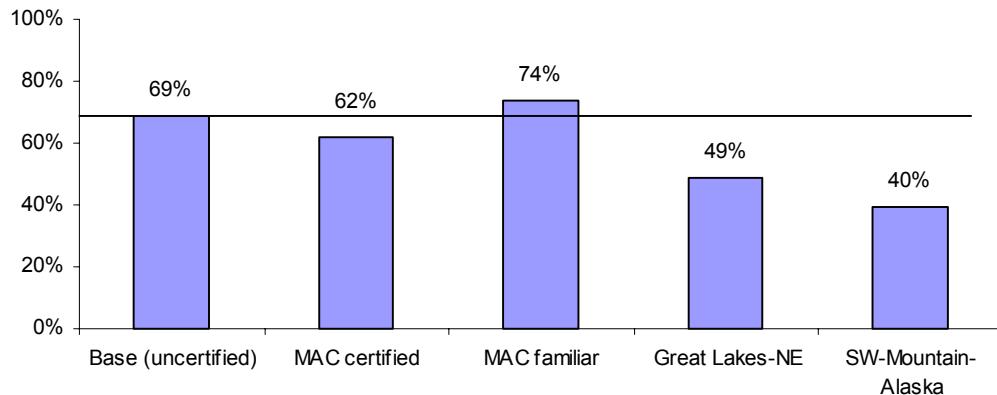


Figure 4-21. Likelihood that the base hobbyist would pay a 15-17% premium for a wild-caught Indonesian blue-faced angelfish with an extended life warranty by various hobbyist characteristics

Simulations for model 3 illustrate the probability of buying a certified fish over a fish with an extended life warranty (i.e., 14 days) at the same price (Figure 4-22). The base probability is 50%, which is the probability that the hobbyist with the base characteristics would prefer certification over an additional 9 days warranty.

Again, not considering coral reef protection as a compelling factor to buy a certified organism appears to reduce the probability of purchase by about 60% (i.e., from 50% to 20%). Familiarity with the MAC program has a positive effect on likelihood to purchase (Figure 4-22). If consumers have at least some level of familiarity with the MAC program, their likelihood to prefer certification to an extended life warranty increases by 26% when compared to the base (i.e., from 50% to 63%).

Income level also shows positive impacts (Figure 4-22). Respondents with income levels between \$25,000 and \$75,000 increase their probability of purchasing the certified fish by about 40%-42%, keeping other variables at the base. Again, the two income categories show similar effects on preferences.

Note that in comparison to model 1 where there was a 15% premium, respondents were only 2% more likely to buy a certified fish at the same base levels although there was not any associated price increase. This observation suggests that price is not an important issue influencing purchase decisions. Moreover, this observation suggests that MAC certification, by itself, is not as environmentally compelling as expected for this segment of respondents, especially when a substitute attribute is offered.

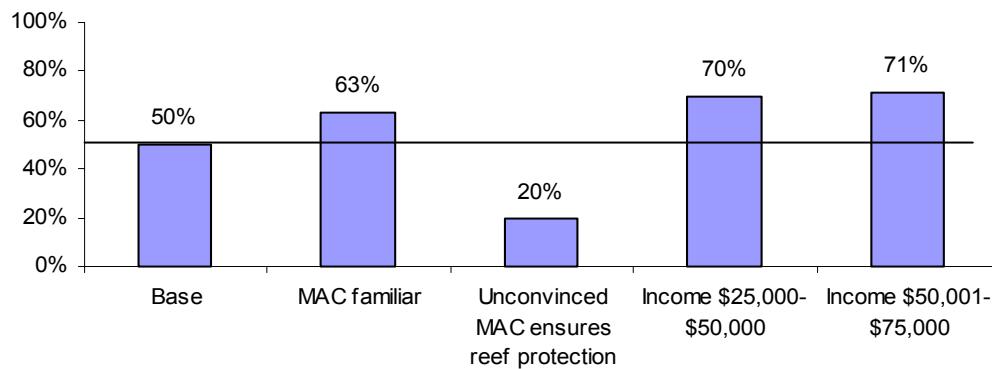


Figure 4-22. Probability that the base hobbyist would prefer a wild-caught certified Indonesian blue-faced angelfish to an extended survival guarantee at a constant price

The simulated effects on the probability of purchase for a certified and 14-day guaranteed fish at a 35% price premium had a base level of 75% (Figure 4-23). For this scenario, the only factor that would increase the likelihood to purchase a fish as specified is the familiarity with the MAC program. Again, hobbyists that were at least somewhat familiar with the program increased their likelihood to purchase by over 17% (i.e., from 75% to 88%). As observed in previous scenarios, respondents who did not consider preventing coral reef damage as justifying buying a certified fish decrease their likelihood of purchase. They had a 41% lower probability (i.e., reduction from 75% to 44%)

paying a premium for a certified fish when it also has an extended life warranty (Figure 4-23).

The negative effect of U.S. geographic location was also observed in this scenario (Figure 4-23). U.S. hobbyists have at least a 24% lower probability of purchasing a certified fish as specified, in comparison to the base. The effect of the Southeast region was not statistically different from zero and it was not considered in this analysis.

At the same base levels, the base probability for willingness to pay a higher premium for a fish featuring certification and extended survival guarantee was higher than the base probabilities showed in the previous scenarios (i.e., 75%). This observation indicates two main things. First, that the specific segment of participants in this survey do not weight price considerations as heavily as other fish attributes, especially those related to environmental issues. Second, considering the preferences for extended survival guarantees observed in model 2, it is concluded that the increased likelihood to purchase in model 3, was also related to an extended life warranty for the fish.

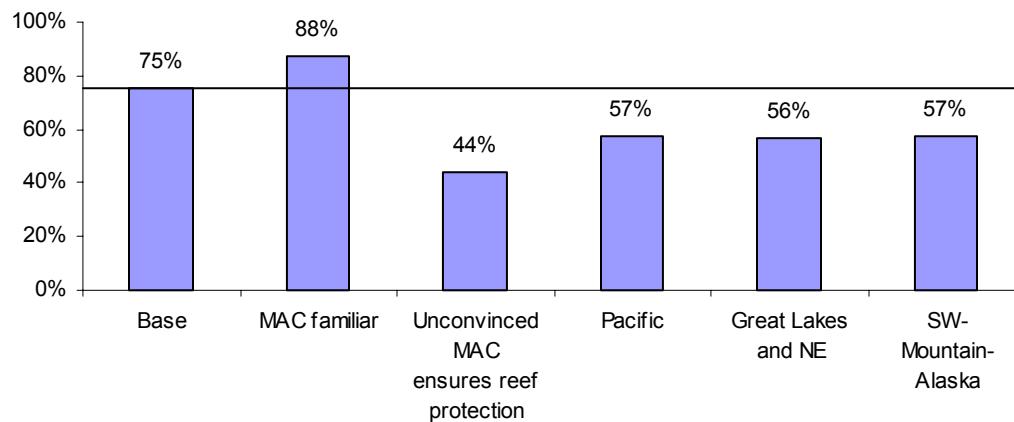


Figure 4-23. Probability that the base hobbyist would pay a 35% premium for a certified and extended warranted blue-faced angelfish wild-caught in Indonesia

Considering the effects that significant variables had on probabilities of purchase for each of the scenarios analyzed, the main implications are summarized below:

- In general, results suggest that “arrive alive-stay alive” life warranty and certification (ecolabels) are perceived as substitutes by avid hobbyists surveyed in this study.
- This unique group of respondents seemed to have stronger preferences for survival guarantees than for environmental certification.
- Considering prevention of coral reef and wild stock damage as compelling reasons to buy a MAC ecolabelled organism influences positively preferences for certification.
- Increasing the familiarity with the MAC program also has high positive contributions to the likelihood of purchase a MAC ecolabelled organism.
- Members of this particular segment of the consumer market who reside in the U.S., especially in the Pacific, Central and Northeastern regions, show a reduced likelihood to purchase certified specimens. Further research investigating the existence of factors influencing the opinions of hobbyists from the U.S. market would be useful to validate these results.

### **Respondent Comments to Survey**

Several respondents provided comments with respect to their perceptions about MAC certification program and wild-caught vs. tan-bred sources (Appendix C). They mainly stated their preferences for tank-bred fish over any similar wild-caught specimen (including certified ones) in order to promote safer reefs and to more directly ensure more tank-adaptable organisms, particularly in regards to specimens collected from zones where harmful harvesting methods are known to exist (e.g., the Philippines). Comments also included reasons for the lack of preference for ecolabelled fish. In summary many questioned the credibility of the MAC ecolabeling program.

One of the main reasons underlying the reduced credibility of MAC certification, as perceived by the survey respondents, was the absence of an effective cyanide-testing program. Some respondents do not believe that the MAC program is effectively

deterring the use of this harmful collection method in certified collection areas. Therefore, they believe no real conservation of reef ecosystems and wild stocks is being achieved. In addition, some respondents indicated their lack of trust on the program with respect to the effective monitoring of practices throughout the chain of commercialization. They are concerned about certified operators selling marine aquarium organisms as certified, although they do not come from certified collection areas. They are also concerned about the lack of tests to ensure standards for improving fish health and chance of survival are being met. Lastly, some respondents indicated doubts about the real objectives of the Marine Aquarium Council regarding money use and about the applicability of the program for small-scale operators.

Some respondents indicated a potential support for the MAC program for wild-caught specimens. They stated that their aversion to certified organisms could be reduced only if they are absolutely sure about the effectiveness of the program to ensure proper collection and handling of organisms and the sustainability of reef ecosystems. In this context, the effective implementation of a cyanide-testing program is a crucial issue to increase credibility. Finally, some comments indicated the necessity of informing consumers about the objectives and actual environmental achievements of the program.

In the context of the reported concerns, taking advantage of the information generated by the system of custody, beyond the label, could be useful for MAC. Providing buyers specific information on collectors and regions (e.g., from paper trail) where certified specimens come from could help reduce the concern of fraud at the retail level (i.e., placing the MAC label in a tank which contains specimens from areas actually not certified by the program) and also could increase the perception and utility obtained

from certified species, given the luxury nature of the hobby and characteristics of the market segment.

### **General Implications**

As it was preliminary hypothesized, members of this segment can be characterized as well informed hobbyists, with avid participation in the aquarium hobby and high interest in preservation of marine ecosystems. Interestingly, only the minority of respondents showed a high level of familiarity with the MAC certification program for wild-caught fish, and the majority actually prefer tank- bred specimens as a mean to avoid harming the ecosystem.

For both experiments, it was observed that, according to expectations, price is not the most important attribute considered when purchasing marine ornamental fish. In addition, marine ecosystem implications have a high influence on observed preferences.

On the other hand and contrary to hypotheses, MAC certification did not positively influence consumers' purchase decisions. Moreover, a MAC certified fish is likely to be less preferred in comparison to cultured and/or guaranteed fish. With respect to observed attitudes towards MAC certification, the following observations can be made:

- Although respondents show high levels of interest in environmental issues, most of them do not consider the MAC environmental certification program as an effective means for promoting sustainability of reef ecosystems and fish quality.
- Although respondents have shown that price is not an issue when deciding to buy a fish given their past purchase behavior (i.e., highest prices paid), their willingness to pay for an ecolabelled fish limited.
- Positive effects of familiarity with the MAC ecolabeling program on preferences for certified fish depended on hobbyists that were only somewhat familiar with the program.
- Higher preferences for the MAC ecolabel among this segment of respondents could be achieved by focusing the program on providing support that it prevents coral reef damage and promoted sustainability of wild stocks.

In comparison to a previous study of preferences for marine aquarium ornamentals at different levels of the marketing channel (Rubinstein 2003) , fish attributes such as tank-bred and survival guarantees are also likely to be preferred to certification by hobbyists. Likewise, an increased familiarity with the program showed a positive significant impact on preferences for MAC certified fish. However, most of the participants in the present study did not have a strong familiarity with the MAC program and the reduction of the negative effect of MAC certification was due to a limited level of familiarity only.

Contrary to expectations, respondents from regions affected by the aquarium industry are not likely to have a positive influence on preferences for the MAC ecolabel. Finally, only for the case of a higher value specimen restricted to collection from the wild (i.e., blue-faced angelfish), some demographic characteristics like education, income, and age supported the hypothesis of positive influences on MAC preferences.

## CHAPTER 5

### SUMMARY AND CONCLUSIONS

The Marine Aquarium Council (MAC) ecolabeling program is a means to promote the sustainability of saltwater ornamental fish and coral reef ecosystems through market mechanisms. Information about potential influences on consumers' purchase decisions, including preferences for the MAC ecolabel, is needed to assess the potential effectiveness and success of the program.

The main purpose of this research is to provide information about the influence of selected fish attributes, including ecolabels, as well as the impact of individuals' characteristics on preferences for marine aquarium fish at the final consumer level. To achieve the purpose, an Internet-based survey was implemented following a discrete choice experiment technique. Two discrete choice experiments were conducted to analyze the importance of attributes in purchase decisions. One experiment presented a high-value specimen, the blue-faced angelfish, and the other introduced a very affordable and popular fish, the maroon clownfish. The former was used to analyze the effects of price, MAC certification ecolabel status and the length of a post-purchase survival guarantee on hobbyist preferences. The latter investigated the effects of price, certification status and fish source (wild-caught or tank-bred). The angelfish and clownfish were assumed from Indonesia and the Philippines, respectively.

The sample of respondents addressed in this research represented a specific group of individual hobbyists, members of on-line discussion boards who were recruited following a convenience sampling approach. Considering that this sample is unlikely to

represent the entire population, the validity of the reported results is limited to this specific segment.

Descriptive analysis showed that this segment of respondents represents a very homogeneous group in general. Most of them are males between 24-44 years old, with above average levels of education and annual income. They are aware of, and give considerable importance to, protection of coral reefs and wild stocks.

As hypothesized, they show a particularly high level of involvement in and knowledge about their hobby. Around 80% consider keeping marine aquaria as their primary hobby, 59% are members of an aquarium society, 88% research the specimens they keep, and over 60% have been paid more than \$50 for a single fish. Contrary to expectations, about 50% are not at all familiar with the MAC certification ecolabeling program.

Observations from the choice experiments were analyzed through binary probit models using maximum likelihood procedures. The estimated models were used in simulations to illustrate probabilities of change in consumer behavior given changes in the values of statistically significant explanatory variables.

Results from both exercises showed interesting and unexpected findings. As hypothesized, price was observed to be a secondary factor influencing purchase behavior, however price was positively related to increases in the likelihood of purchase. Contrary to expectations, the role of MAC certification was perceived as a close substitute for other fish attributes (i.e., extended life warranties and tank-bred specimens), with less strong or even negative effects on purchase behavior. An important observation is that respondents' comments revealed a strong lack of credibility for the MAC program and a

higher confidence in alternatives such as tank culture as a means to avoid harmful consequences related to collection from the wild.

For the maroon clownfish experiment, an extreme preference for tank-bred fish was observed. When compared to a wild-caught fish, with price kept constant, tank culture as a source increased the probability of purchase remarkably. This considerable increase was observed for both levels of certification status, although the effect was larger for an uncertified specimen. Simulations also showed that regardless of price variations, respondents seem increasingly willing to buy tank-bred fish, although at a diminishing rate with incremental increases in price.

On the other hand, the effect of MAC certification at a constant price was negative. When compared to an uncertified specimen, the likelihood that an avid hobbyists would purchase a certified fish decreased for both wild-caught and tank-bred fish, although the decrease was larger for a tank-bred fish. However, simulations with price increases showed that respondents' willingness to pay for certification increased at an increasing rate if the fish was wild-caught and at a decreasing rate if the fish was cultured. Such observations suggested that avid hobbyists would be increasingly likely to pay price premiums associated with MAC certification if a fish is caught in the wild. Respondents seemed to be concerned with ecosystem protection. However, they would not pay price premiums for certification if the fish was tank-bred. This result suggests a low market potential for an extension of the MAC program to cultured specimens, at least among this segment of hobbyists. Furthermore, since several clownfish species are available from culture, this observation could be applicable to other clownfish species.

In the case of the blue-faced angelfish, respondents' preferences were analyzed in four different scenarios. Results revealed that an extended survival guarantee (by 9 days) and ecolabel were perceived as close substitutes in terms of ensuring better quality fish collected from the wild. However, the positive influence of extended life warranties on purchase decisions was higher than the effect of the MAC ecolabel. In addition, it was again observed that this specific segment of hobbyists did not weigh price considerations as heavily as other attributes, especially those related to environmental issues.

The effects of respondents' characteristics on preferences for MAC certification were also analyzed in both experiments. Increasing the level of familiarity with the MAC program and the association of effective prevention of coral reef and wild stock damage with the MAC ecolabel showed highly significant positive influences on preferences for certification by avid hobbyists. This confirms the initial hypothesis that marine ecosystem implications have a high influence on preferences for saltwater ornamental fish for this group of hobbyists.

Demographic variables like age, income level, education and geographic distribution also showed significant influences on preferences for certification, but only in some of the blue-faced angelfish scenarios. Results showed that those respondents older than 44 years, who have at least a college education and an annual income between \$25,000 and \$75,000 were more likely to choose a certified fish at the specified price premium.

On the other hand, and contrary to initial expectations, regions exposed to the aquarium industry did not show a positive reaction to certification. Moreover, in comparison to international hobbyists, results indicate that respondents from the U.S.

were less likely to purchase a certified fish. Such a result suggests a stronger perception of survival guarantees as a substitute for certification (ecolabeling) when considering fish quality. Further research to confirm this finding is needed.

Considering the observed negative perception for the MAC ecolabel, the market potential of the program for this group of hobbyists looks limited. However, since only 50% of respondents have some level of familiarity with MAC, efforts to improve the level of knowledge and perceived credibility of the program are recommended. Focusing efforts on an effective diffusion of the program's scope of action and promulgating plans the Marine Aquarium Council has to address not only coral reef protection but also sustainability of fish stocks and efficient post-harvest activities (i.e., handling, holding and transportation). Such information could be very useful and successful in improving preferences for a MAC ecolabel.

It is important to note that although results from this research do not apply to the entire population of marine aquaria owners, an understanding of the preferences of this specialized group could be very useful for creating market diffusion strategies. Due to their level of involvement in the hobby and high exposure to information, these respondents should be easier, faster and cheaper to reach with educational and promotional efforts. In addition, due to the secondary role that price plays in influencing purchase behavior and the increased capacity to afford price premiums, this group would be very likely to react positively to price increases and to contribute to support of the program, if their preferences for the MAC ecolabel are improved. Lastly, a survey of the general population and those covering additional species, would be useful in obtaining a better estimate of overall demand. A study of expected costs associated with becoming

and remaining certified could also help estimate expected premiums associated with the ecolabel.

## APPENDIX A

### SURVEY INSTRUMENT AND CODING

#### **Section 1 of 3: Background and Opinions**

Q1 What is the total size of tanks that you currently maintain?

Q1.A Saltwater

- 0     None (I do not have an active tank)
- 1     1 to 9 gallons (1 to 36 liters)
- 2     10 to 24 gallons (37 to 93 liters)
- 3     25 to 49 gallons (94 to 188 liters)
- 4     50 to 74 gallons (189 to 283 liters)
- 5     75 to 99 gallons (284 to 377 liters)
- 6     100 to 180 gallons (378 to 683 liters)
- 7     More than 180 gallons (More than 683 liters)

Q1.B Freshwater

- 1     1 to 9 gallons (1 to 36 liters)
- 2     10 to 24 gallons (37 to 93 liters)
- 3     25 to 49 gallons (94 to 188 liters)
- 4     50 to 74 gallons (189 to 283 liters)
- 5     75 to 99 gallons (284 to 377 liters)
- 6     100 to 180 gallons (378 to 683 liters)
- 7     More than 180 gallons (More than 683 liters)

Q2 Please indicate whether you plan to change your saltwater tank capacity within the next two years:

- 1     Increase
- 0     No change
- 1   Decrease

Q3 Regarding your saltwater aquarium hobby, how long have you maintained a tank?

- 0     I do not have a tank
- 1     Less than a year
- 2     1 to 10 years
- 3     11 to 20 years
- 4     More than 20 years

Q4 Please identify the range that contains the highest price you have ever paid (excluding tax and shipping, if applicable) for a single aquarium finfish and invertebrate (shrimp, giant clam, etc.):

Q4.A Saltwater finfish

- 0     U.S.\$0 (I have not purchased before)
- 1     Less than \$10 U.S.

- 2      \$10 to less than \$25 U.S.  
 3      \$25 to less than \$50 U.S.  
 4      \$50 to less than \$75 U.S.  
 5      \$75 to less than \$100 U.S.  
 6      \$100 U.S. or more

**Q4.B Saltwater invertebrate**

- 0      U.S.\$0 (I have not purchased before)  
 1      Less than \$10 U.S.  
 2      \$10 to less than \$25 U.S.  
 3      \$25 to less than \$50 U.S.  
 4      \$50 to less than \$75 U.S.  
 5      \$75 to less than \$100 U.S.  
 6      \$100 U.S. or more

**Q5 Where do you spend the most money purchasing live saltwater specimens?**

- 1      Local general pet store  
 2      Local aquarium store  
 3      Internet  
 4      Other  
 5      Not applicable (I do not have a saltwater tank)

**Q6 The following yes/no questions are about your interests.**

	Yes (1)	No (0)
Q6.A Have you ever visited a coral reef?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.B Is keeping an aquarium your primary hobby?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.C Have any species reproduced in your tank?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.D Have you ever done research on the specimens you keep in your tank?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.E Have you ever bought a fish or invertebrate that was bred in a tank instead of caught in the wild?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.F Are you a member of any environmental organization?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.G Are you a member of any aquarium society?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.H Do you have a "fish only" tank?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Q6.I Do you have a "reef" tank?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

**Q7 How familiar are you, if at all, with the Marine Aquarium Council (MAC) certification program?**

- 0      Not at all familiar  
 1      Somewhat familiar  
 2      Very familiar

**Section 2 of 3: Choice Exercises**

You will be presented with a series of choices between two fish. The fish will differ either by one or more of the following characteristics:

- price (U.S. \$/fish, before any taxes and shipping charges)
- length of survival guarantee (i.e., number of days it will survive after you take possession)
- source (wild-caught or bred and raised in a tank)
- environmental certification status (if MAC-certified)

The survival guarantee provides for either another fish or your money back. The environmental certification (i.e., MAC-certification) applies only to wild-caught species and indicates whether the fish was collected using "reef safe" methods that minimize damage to coral reefs or other plants and animals and transported under low stocking densities. The Marine Aquarium Council (MAC) developed the certification program and it is voluntary. Certification is provided by independent agencies that monitor compliance using annual unannounced visits.

There are two sets of choices, the first for blue-faced angelfish (*Pomacanthus xanthometapon*) and the second for maroon clownfish (*Premnas biaculeatus*). Your choices will be combined with all others we receive for analysis

How familiar are you, if at all, with each of these species?

	Not at all familiar (0)	Somewhat familiar(1)	Very familiar (2)
Blue-faced Angelfish	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Maroon Clownfish	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>



**Scenario:** You have decided to purchase a medium (approx. 4") blue-faced angelfish (*Pomacanthus xanthometapon*) today. When you go to buy the fish, you find that you have a choice between two. Both have been collected from the wild in the Philippines and they appear to be identical. Given what you know about this species and the industry, which would you choose?

Blue-faced angelfish choice 1 of 6:

FISH F	FISH J
\$99.99	\$84.99
Wild Caught from Philippines	Wild Caught from Philippines
Not Certified	Not Certified
14-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Blue-faced angelfish choice 2 of 6:

Note: Please consider each choice independently. Do not try to recall past choices or anticipate future choices.

FISH J	FISH H
\$84.99	\$99.99
Wild Caught from Philippines	Wild Caught from Philippines
Not Certified	MAC-Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Blue-faced angelfish choice 3 of 6:

FISH H	FISH F
\$99.99	\$99.99
Wild Caught from Philippines	Wild Caught from Philippines
MAC-Certified	Not Certified
5-day Live Guarantee	14-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Blue-faced angelfish choice 4 of 6:

FISH M	FISH J
\$114.99	\$84.99
Wild Caught from Philippines	Wild Caught from Philippines
MAC-Certified	Not Certified
14-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Blue-faced angelfish choice 5 of 6:

FISH H	FISH M
\$99.99	\$114.99
Wild Caught from Philippines	Wild Caught from Philippines
MAC-Certified	MAC-Certified
5-day Live Guarantee	14-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Blue-faced angelfish choice 6 of 6:

FISH M	FISH F
\$114.99	\$99.99
Wild Caught from Philippines	Wild Caught from Philippines
MAC-Certified	Not Certified
14-day Live Guarantee	14-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>



**Scenario:** You have decided to purchase a small (approx. 2") gold-striped maroon clownfish (*Premnas biaculeatus*) today. When you go to buy the fish, you find

that you have a choice between two. Both are offered with a 5-day live guarantee and they appear to be identical. Given what you know about this species and the industry, which would you choose?

Maroon clownfish choice 1a of 6:

FISH P	FISH T
\$24.99	\$21.99
Wild Caught from Indonesia	Tank Bred
Not Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 1b of 6:

FISH Q	FISH U
\$24.99	\$21.99
Tank Bred	Wild Caught from Indonesia
Not Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 2 of 6:

Note: Please consider each choice independently. Do not try to recall past choices or anticipate future choices.

FISH T	FISH N
\$21.99	\$24.99
Tank Bred	Tank Bred
Not Certified	MAC-Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 3a of 6:

FISH N	FISH P
\$24.99	\$24.99
Tank bred	Wild Caught from Indonesia
MAC-Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 3b of 6:

FISH G	FISH Q
\$24.99	\$24.99
Wild Caught from Indonesia	Tank Bred
MAC-Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 4a of 6:

FISH R	FISH T
\$27.99	\$21.99
Wild Caught from Indonesia	Tank Bred
MAC-Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 4b of 6:

FISH S	FISH U
\$27.99	\$21.99
Tank Bred	Wild Caught from Indonesia
MAC-Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 5a of 6:

FISH N	FISH R
\$24.99	\$27.99
Tank Bred	Wild Caught from Indonesia
MAC-Certified	MAC-Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 5b of 6:

FISH G	FISH S
\$24.99	\$27.99
Wild Caught from Indonesia	Tank Bred
MAC-Certified	MAC-Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

Maroon clownfish choice 6 of 6:

FISH R	FISH P
\$27.99	\$24.99
Wild Caught from Indonesia	Wild Caught from Indonesia
MAC-Certified	Not Certified
5-day Live Guarantee	5-day Live Guarantee
Select >> <input type="checkbox"/>	Select >> <input type="checkbox"/>

### Section 3 of 3: Respondent Opinions and Information

Q8 In your opinion, how compelling are each of the following reasons for purchasing tank-bred and raised (i.e., cultured) saltwater specimens?

	Has no influence on Very compelling decision			
	Not at all compelling	0	2	
Q8.A Preserves the sustainability of identical wild-caught stocks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q8.B Prevents potential damage to coral reef habitat from collection of wild specimens.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q8.C Specimens are more adapted to a tank environment (i.e., more hardy) than wild-caught specimens.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q8.D Specimens are more readily and consistently available than wild-caught specimens.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q8.E Regulations for tank bred and raised fish adequately protect the environment surrounding the breeding and raising facilities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q9 In your opinion, how compelling are each of the following reasons for purchasing wild-caught MAC-certified (i.e., "reef safe") saltwater specimens?

	Has no influence on Very compelling decision			
	Not at all compelling	0	2	
Q9.A Prevents unnecessary mortality during collection and transport compared to wild-caught specimens.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q9.B Prevents damage to coral reef habitat during collection as compared to un-certified specimens.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q9.C Prevents overfishing of specific species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q9.D Specimens are healthier (i.e., less stressed, more hardy) than non-certified specimens.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q9.E The certification program for seafood, the basis for the MAC program, has been successful at protecting and preserving habitats in the wild.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q10 In your opinion, what is the market potential of unique marine aquarium specimens created using each of the following production techniques? Please consider each individually.

	Lowest potential -2	Moderate potential 0	Highest potential 2	
Q10.A Selective breeding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q10.B Improved diets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q10.C Use of hormones	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q10.D Use of genetic modification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q11 Given what you know about transgenic ornamental fish, how likely are you to purchase such organisms in the future?

- 0      Very likely
- 1      Somewhat likely
- 2      Not at all likely
- 3      Undecided

Note: If you would like to comment about any of the issues raised on this page, you will have that opportunity on the next page. Thank you for continuing.

Q12 What is your gender?  Male (1) or  Female (0)

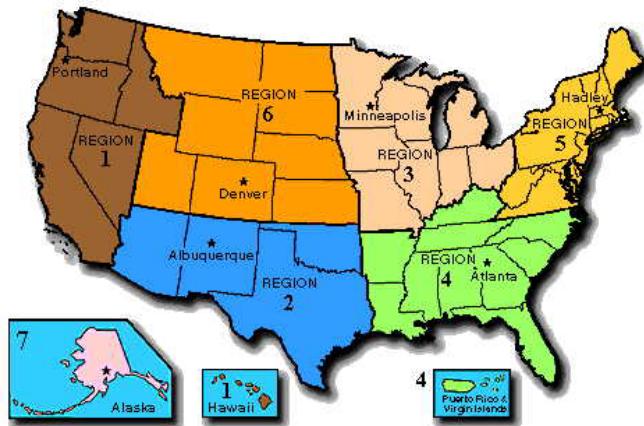
Q13 In what year were you born?

- 1      Before 1920
- 2      1920 through 1929
- 3      1930 through 1939
- 4      1940 through 1949
- 5      1950 through 1959
- 6      1960 through 1969
- 7      1970 through 1979
- 8      1980 through Feb.1986
- 9      After February 1986

Q14 In what region of the world do you currently live?

- 1      North America
- 2      Central America or the Caribbean
- 3      South America
- 4      Australia or New Zealand
- 5      Indonesia
- 6      Asia
- 7      Middle East
- 8      Africa
- 9      Europe or Greenland

Q15 If your residence is in North America, in what region? (Please use the map below to identify U.S. regions)



**U.S. Fish & Wildlife Service Regions**

- 1 U.S. Pacific (Region1)
- 2 U.S. Southwest (Region 2)
- 3 U.S. Great Lakes-Big Rivers (Region3)
- 4 U.S. Southeast (Region 4)
- 5 U.S. Northeast (Region 5)
- 6 U.S. Mountain-Prairie (Region 6)
- 7 U.S. Alaska (Region 7)
- 8 Canada
- 9 Mexico

Q16 What is the approximate size of the community that you live in?

- 1 Population less than 25,000
- 2 Population 25,001 to 50,000
- 3 Population 50,001 to 100,000
- 4 Population 100,001 to 250,000
- 5 Population 250,001 to 500,000
- 6 Population 500,001 to 1 million
- 7 Population over 1 million

Q17 What is the highest level of formal education that you have completed?

- 1 Less than high school (secondary)
- 2 High school (secondary) graduate
- 3 Some college or technical degree
- 4 College graduate
- 5 Some graduate school
- 6 Graduate degree

Q18 In what range was your total household income (before taxes) in 2003?

- 1 Less than \$25,000 U.S.
- 2 From \$25,001 to \$50,000 U.S.
- 3 From \$50,001 to \$75,000 U.S.

- 4      From \$75,001 to \$100,000 U.S.
- 5      From \$100,001 to \$199,000 U.S.
- 6      At least \$200,000 U.S.

Thank you for your time in completing this questionnaire.

If you have any comments about the topics covered, questions asked, or the web site in general, please provide them in the space below.

**APPENDIX B**  
**SUMMARY DESCRIPTIVE STATISTICS**

Variables	Mean	Standard Deviation
<i>Blue-faced Angelfish</i>		
PRICE	99.99	11.08
CERT	0.50	0.52
GUAR	0.50	0.52
<i>Maroon clownfish</i>		
PRICE	24.99	2.12
CERT	0.50	0.50
TANK	0.50	0.50
PRCR	13.24	13.28
PRTK	12.12	12.21
CRTK	0.25	0.43
CRTKPR	6.44	11.17
<i>Respondents characteristics</i>		
MCFAM	0.98	0.11
DMACFAM	0.51	0.50
RFCOMP	0.86	0.35
FISHCOMP	0.85	0.36
AGE1	0.10	0.30
AGE2	0.38	0.48
AGE3	0.33	0.47
AGE4	0.18	0.38
DINTL	0.10	0.30
PACIF	0.14	0.35
SE	0.16	0.36
LAKESNE	0.48	0.50
SWMNTAL	0.11	0.32
DEDUC	0.90	0.30
DINCOME1	0.05	0.22
DINCOME2	0.17	0.38
DINCOME3	0.22	0.41
DINCOME4	0.56	0.49

## APPENDIX C

### CATEGORIZATION OF INDIVIDUAL COMMENTS

#### **Lack of Credibility on the MAC Ecolabeling Program**

1. Always buy tank-raised fish and frags when possible.
2. MAC has potential, but currently no credibility. MAC certification will carry little to no weight in my purchasing decisions until there is backbone behind the certificate. In all fairness though, I do not expect instant results, and realize that the socio-economic climate in both the collection areas and the legislative arenas typically does not change rapidly.
3. MAC does not mean that much to many in this hobby. I suspect it does not mean that much to people in the trade. Not a great reputation and I think it will throw off the results of your survey.
4. If I knew that the fish came from the Philippines Islands, I would not touch it at any cost.
5. I would not buy any blue-faced or full-sized angle fish for any reason.
6. I am a member of Reefs.org and as you most likely know, many of the members of this forum are not highly impressed with the MAC certification. One of the main problems that have come to mind (which I believe is the main reason for this survey) is to see if someone would buy a MAC certified fish or a non-certified one. I believe that this survey is not fully going to get to the kind of aquarium keepers you are looking for. The newbies to the hobby do not care if a fish is MAC certified or not. They will be thinking, “why is this one \$10 cheaper?” and they will buy the cheaper one because they do not care about MAC certification.
7. The worth of MAC is in the ability to implement the theories and notions that excite uninvolved people. Inside the industry MAC is tolerated as an amateur group out to milk the issues and problems of the trade without getting wet. They have been at it for 5 years and have not been able to train divers in the field due to their own field incompetence. This appears to not be changing as their field people tell them what they want to hear while hiding their poor results in training divers. MAC certified exporters in Manila currently sell cyanide to divers right out of their facilities! In the Philippines, this is well known. MAC is a joke in professional circles, tolerated because of its “PR” value making it appear that something is being done.
8. MAC is afraid to implement a real cyanide-testing program. Tank-bred fish or larval raised wild-caught are the real deal.

9. I am not a believer in MAC in its current form. Transportation (ensuring non MAC are not mixed with MAC) and enforcement are the main issues, that and the lack of tests to ensure standards are met.
10. I do not understand the purpose of this survey other than a MAC marketing tool. While I fully support the efforts of MAC, and have gone to lengths to show their material at our local aquarium society, I still do not see anything actually happening. From talking to local retailers, some of the requirements are unachievable even through the best of practices.
11. MAC has proven to be ineffective as a deterrent to cyanide use. The practice of cyanide is still widespread. Therefore I would not purchase these fish if I knew they originated in the Philippines without first checking the importer that sold them to the local fish store.
12. I had difficulty completing the survey because I do not purchase wild-caught specimens except on very rare occasions when widely available animals (certain types of shrimp, etc.) are not available captive bred. Otherwise, I choose something else. So a certificate of wild capture is not relevant to me.
13. I believe the key to saving reefs is to grow your own and reduce the wild-caught corals and fish.
14. I prefer tank-raised or cultured saltwater fish, invertebrates, live rock, and live sand whenever possible. I have little data to say if programs such as MAC are actually effective in improving the conditions of livestock collection and the impact on natural reefs, or if they are really just tools used by the livestock industry to sooth consumer protest while the poor collection techniques continue. My purchases will prefer livestock not collected from natural reefs, and otherwise only slightly prefer livestock collected certified over non-certified, unless there becomes better data to show that such certification is really effective.
15. I propagate coral in my tanks and I buy fish and coral that are tank-bred if I can. It keeps the reefs safer and it gives you animals that will survive and thrive in a tank.
16. I had a more difficult time answering the questions about the angel because it really would not be an option for me to ever buy one. I only buy captive raised or bred fish.
17. I feel that the MAC certification process is currently not effective. I would have voted differently on the fish choices if an effective certification for cyanide detection were established. I do not feel that MAC certification means the fish was not caught with cyanide because of the lack of testing.
18. MAC certification will not hold much weight until it can get its act together and not be a complete scam. Its current processes appear to be more geared towards making money than making a sustainable hobby.

19. While I, like almost any empathetic aquarist with a shared admiration of the sea, wholly agree with the sentiment of MAC's mission statement, their refusal to acknowledge key questions put to them at conferences and other sessions leaves me unclear if not mistrusting of their abilities/intent. Frankly, after so many years of MAC preaching to make change and the fielding of staggering amounts of money from the Packard foundation, and others. I just do not see where the money has been put to good use. I am having trouble supporting their mantra on sustainable use of resources when they speak from headquarters in Hawaii while sitting in some of the most expensive office space in the world. It is like a fat man lecturing on gluttony. If they do not want the label of being money-grubbing bureaucrats looking for comfy jobs in paradise, they could start by saving some of that money in precious donations needed by the island peoples, reefs and communities they claim to want to help with headquarters in more humble settings. I will not support MAC until they can demonstrate that they can make a change and that their use of fiscal resources is responsible.
20. I love fish and would like to buy only tank-raised if possible. The more expensive the fish, the better the warranty. No one wants to take a chance and flush \$100 bucks down the toilet.
21. Regarding fish, I rank it in the following order: 1. Tank-raised/bred 2. MAC certified 3. Other 4. Wild-caught. Other includes swap/trade with other marine reef keepers if a fish does not work out for them, whatever. I do what I can to avoid taking it off the reef. You need to add issues like coral collection and live rock collection to this survey.
22. Tank-raised/propagated beats everything hands down. I would pay more for tank-raised specimens because a) I know that coral reef environments and sustainable fish populations on them were not harmed, and b) they are much more tolerant/maintainable in the artificial reef environment we have in our tanks. I was not influenced too much by the alternate periods of guarantee. If I can acclimate something over five days without losing it, then I am relatively certain I am not going to lose it in 14. The few losses I have had have always been within the first 48 hours, or else way beyond 14 days.
23. I have heard of MAC before, and besides raising the price of my fish and potentially driving several of our local stores out of business, I do not see the benefit of this certification. The local stores in my area are terrific for the most part, and already promote environmental collection techniques by only buying from reputable suppliers. Although I think that the idea that MAC is trying to encourage is a good one, I do not see the benefits of the system at the local level. This is something that should be implemented at the wholesaler level and not the local store level.
24. To whom it may concern, I found this survey very interesting and am curious as to why UF is so interested in this subject. Is the University's agriculture department considering branching out into saltwater aquiculture? As to the questions on MAC

certified fish, I would like to give some insight to this. I am a manager at an aquarium store, and we mainly specialize in saltwater. We are members of MAC and I support the concept, but based on personal experience from buying from several different wholesalers you do not know if the fish you are buying are MAC certified. I thought that all of them are members of MAC. The wholesalers use so many different suppliers, so when you buy livestock you almost never know where exactly that species of fish came from or if it is certified.

25. I am glad to see that more interest is being taken on this issue! I am a small time coral farmer and writer, and I have always been a big proponent of mariculture. My biggest gripe with MAC is that it is not a realistic certification for someone who is not a large-scale operation. For this reason, there are very few MAC-certified stores in the San Francisco Bay Area.
26. Most important in purchase of a saltwater fish/invertebrate is if it is captive-bred or captive-raised. I believe this is more important than a survival guarantee (it is my responsibility to provide proper husbandry and to research the specimen's requirements), or price. Survivability/adaptability is higher versus wild-caught; in my experience/opinion. MAC certification is good, but how will it be enforced at the local store or Internet retailer? How as a consumer, do I know the specimen is really certified and not just placed in a tank with a sticker stating it is so?
27. Due to my own online research, I have decided that the MAC program is not sufficient to guarantee that certified fish are any different than non-certified fish. Until MAC requires that all shipments are tested for cyanide, I will have no use whatsoever for MAC certified fish, and would not spend a penny more on them. On the other hand, tank-raised means a lot to me, and I will always support tank-raised operations when I can.
28. I found your questions very interesting, and I tried to be very honest in my response. I am certainly concerned about the environment, using both concrete live rock and tank-raised fish where available. But the MAC certification has little meaning to me, and in all honesty after having learned about it from your site I still found that it did not sway my feelings regarding price/environment very much. I guess I really do not see it as being effective.
29. My main concern with buying a MAC-certified fish is that it may be a fake. The fish do not have a certification tattooed in the body so there is no way to tell if the fish is actually certified. I have a feeling a lot of LFS owners will be selling fish claiming they are MAC-certified and in actuality they are not. That is my biggest concern. If I knew 100% for sure the fish was certified, I would probably choose that fish, but I do not know how I could ever be so confident.
30. Too bad we do not see any props or laws that are really making a difference. Do I prefer tank-raised specimens just because they are "hardy"? Yes, mostly. However, I do not care how unique, awesome, interesting, or hardy a wild-caught specimen is, no matter how it was caught in the wild; or who certified it. If there is trade for a

particular specimen; it should be tank-raised and then certified. Feasible? I am sure it is!

31. I feel like the MAC certification program has good intentions, but I am not convinced that one percent mortality is even possible with the shipping methods used now. I also believe that doa (dead on arrival) records in the hands of a government agency could have severe consequences to the marine aquarium hobby. I have mixed emotions about this whole idea.
32. You did not ask the most relevant question on the issue of wild-caught fish: Q. Because of the rampant use of cyanide in the Philippines and Indonesia, would you support a ban on the import of fish from these countries until certification and cyanide tests are mandatory? A. Yes, because turning a blind eye to this problem, which not only kills most of the fish but the reef and all the critters in it, brings shame to our hobby and risks its closure.
33. First of all I am a relative novice with marine fish though I have a deal of “combat experience” with tricky freshwater fish. When I look at a blue-faced angel for example, I know these are prone to travel stress, and have dietary challenges. For me it is essential that the fish look and behave healthily. Beyond that, the guarantee or MAC certification is irrelevant. If a fish is guaranteed 14 days, rather than 5, I feel early significant mortality from travel stress is probably a big problem. For the clownfish, tank-bred fish are so much tougher than wild-caught. The guarantee and certification is almost irrelevant.

### **Potential Support for MAC**

34. If I had known more about MAC certification, my answers would have leaned more towards the MAC choice for the entire survey. Before this survey, I was unaware of MAC.
35. My general aversion to wild-caught specimens would be reversed if I believed that there was in place a strong structure (either regulatory, or commercial) to ensure sustainable development of the reef for the benefit of both the reef and of local communities. I am not especially price sensitive, I am not romantic about the livestock in my possession but I dislike waste, and I am totally opposed to the collection of endangered species. My knowledge of the collection methods surrounding fish, and their scarcity (local or general) is very sketchy. I am more interested in the corals and invertebrates, where of course captive-bred (or cultured) is more common.
36. I am not aware of the MAC certification, if I were to know the specifics and benefits, I may be more or less inclined to purchase certified stock.
37. Habitat incursion would be my first concern with any wildlife. Right now I am more interested in the macro and microorganism in reefing than in the fish aspect of it. However, based on what I have seen and read recently about the tactics used

in this industry, I have become more involved and interested in what is being done for a solution.

38. I assumed for the study that MAC certified has real meaning. I am unsure if that is the case in reality.
39. Tough comparisons. Fish that appear identical and healthy at a retailer yet were caught using cyanide are more likely to be dead after 15 days than cyanide free fish (that is the only reason to get a “stay alive” guarantee. Yet with a blue-faced angel, almost all wild-caught P.I. blue faced angels are cyanide caught, so the guarantee is useless because I want a living fish, not another, and none of the retailers offer a full money back guarantee. So a MAC certified PI blue-faced angel to me equals a guaranteed to live angel.
40. I believe MAC certification is most useful for wild collected species of fish, which currently are not bred in captivity. I am willing to pay a little more for fish that have been properly collected and handled. I generally avoid wild collected clownfish due to availability of captive bred clowns. I believe MAC’s initial focus should be on wild collected fish, as I believe that is where they add the most value.
41. I hope in the future to see more MAC certifications on websites and in local fish stores so we know when we have a choice of buying these products. I am very much opposed to cross breeding of fish in order to change the characteristics of the original fish (i.e., what they have done to the discus fish with color and patterns).
42. I hate to sound pessimistic, but it crossed my mind that if I voted that I would pay more for a MAC certified fish, then the survey data would be looked at like, “well, people are willing to pay more for MAC certified fishes, so let’s charge them (lots of money, as in overcharge)!” Then I thought, well maybe I do not want to vote that I would pay more for a MAC certified fish, because I would not want to be charged a whole lot more for that fish. I do not know if that makes any sense. Now, I would not mind paying more for a MAC certified fish if I were sure that it was actually better for the environment and for the fish (and thus for me). I understand there would probably be costs incurred in obtaining MAC certification, and I would want to contribute to the payment of those costs, but I do not want to be gouged for it. That is my story and I am sticking to it! Oh, also it is not clear to me what the real purpose is in paying more for a tank-raised MAC-certified fish (it is not wild collected or imported long distances, so why bother, “what is it achieving” type of thing).
43. Please consider the economic impact and reliance ornamental fish collection has in some areas of the world (i.e., little other resources). This indicates that captive breeding has the potential to starve these people out, if MAC etc. are successful. It would be far more effective for fish and people if more percentage of the retail cost could be directed to the areas the fish are caught. Perhaps the choice between HCN and netting boils down to do his children eat, or not, and not the long-term species or environmental effects. One thing MAC could do is approach the airlines with

industry standards of packing and travel (i.e., 2 weeks in QT tank followed by disease management) with a minimum survival rate at destination or no more air transport. The power key to this industry is obviously the shipping! Control and regulate this step and vastly increase overall survival to destination (from an est. of less than 10%) via QT and a “wellness” and you will save more fish and feed more people sustainably.

44. I buy tank-raised fish whenever possible, but if I had to purchase wild-caught fish I would definitely want them MAC certified. I have asked local fish stores if they are participating in the program and I always get the answer of “not at this time as our customers do not want to pay higher prices”. I wonder how the results of this survey will turn out because somehow I do not think the stores are really asking their customers their opinions.
45. I have never heard of MAC certification until today. Knowing nothing about it, it has no influence on my decision. To be honest, if I had heard about it from a setting less “official” than this, I would probably assume it was a gimmick to sell fish. I do not know enough about what goes on during fish collection (use of cyanide, dynamite, whatever) to decide which wild-caught fish are doomed, which is why I prefer tank-raised fish. I judge a fish’s health almost entirely on its appearance, and a tank-raised fish seems less likely to be carrying some invisible malady (e.g., internal illness, effects of cyanide poisoning) than a wild-caught fish.
46. I will choose a MAC over wild-caught every time. I do not like the cyanide approach and when MAC first started sent money to help fund. You should ask questions about tank-raised invert and corals. Many of us pass offspring and cuttings.
47. I would avoid any fish from the Philippines because of the use of cyanide to catch fish. MAC certification helps, but I believe they can improve the cyanide testing. I prefer tank-raised fish. The quality of the tank-raised fish has decreased lately at several local fish stores. The fish have many defects that change their chances of survival. There is a lot of talk about genetically altered fish. Glow in the dark, saltwater fish in fresh water, etc. I find this concept disgusting.

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## BIOGRAPHICAL SKETCH

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