The Environmental and Economic Benefits of Eco-Certification within the Ornamental Fish Trade

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Abstract—**Trade of ornamental fish and aquarium supplies is extensive. The environmental impacts of the trade in ornamental fish are of considerable importance. In addition to this, the economic disparity between the importing and exporting countries within the trade can have social, environmental and economic ramifications for the poorer exporting countries. The research problem explored in this paper focuses on showcasing ways in which the certification program initiated by the Marine Aquarium Council (MAC) can be used as a framework for promoting the sustainability of marine ornamental fish populations and coral reef ecosystems. The MAC framework relies on consumers recognizing and supporting responsible collectors by selectively purchasing from these suppliers. Evidence regarding the likely economic benefits of the MAC system is presented using case study analysis. These case studies are used to examine the hypothesis that MAC certification yields economic benefits that spread from consumers and retailers to collectors, specifically through greater profits for collectors and a higher quality of specimen. However, MAC certified products are generally more expensive than non-certified products. It is a requirement, therefore, that MAC initiatives encourage consumers to prefer certified ornamental fish species that are harvested in an environmentally friendly manner. Studies of consumers' willingness to pay and the potential economic benefits of MAC certification have shown that further promotion of MAC certification and its role in guaranteeing environmental sustainability is required to ensure the competitiveness of MAC certified fish with cheaper alternatives. The general results from these case studies have implications for the global sustainability of many other ocean resources.**

Index Terms—**Eco-certification, economics, MAC certification, marine aquaria trade.**

I. Introduction

The trade in ornamental fish and aquarium supplies is a multi-million dollar industry that spans the globe. The worldwide import value of marine ornamental fish is approximately US$200-330 million whereas the total global retail value of marine ornamental fish and aquarium hobby supplies is approximately US$500 million [1], [2]. This report will examine the economic aspects of the ornamental fish trade and will focus on eco-certification, in particular the certification system developed by the Marine Aquarium Council (MAC), as a solution to the economic and environmental problems associated with the trade. Qualitative research techniques (case studies) are employed to examine the likely effects of MAC certification on the trade in ornamental fish. Case studies can be used to analyze human activity patterns that are embedded in the real world [3], [4]. The use of case studies allows one to: (i) explain the main elements that govern behavior and reward, and/or (ii) explain the phenomenon that is observed or that is likely to occur. In the context of sustainability, it is reasonable to argue that any notion of sustainable multiple seas use or general use of resources of the seas will require an assessment of what is sustainable and/or how sustainability can be achieved.

In this paper, attention is focused on examining the likely benefits that may accrue from eco-certification of aquaria fish harvesting and trade practices. Case study research can thus yield important evidence regarding the likely impact of harvesting strategies. The benefits of case study analyses, for a variety of phenomena, institutions, individuals and activities are widely understood [3]- [6]. Three studies concerning consumer choice of marine aquaria hobbyists will be examined to analyze the receptivity of consumers to eco-certification programs within the marine aquaria trade. The findings of these studies point to the potential of MAC certification as a primary tool in improving sustainability and consumer awareness within the ornamental fish trade.

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II. Overview of the Trade

More than 100 countries are involved in the trade of ornamental fish, with Singapore, Hong Kong, USA, the Netherlands, and Germany representing the top five exporting countries in 1992 [7]. Conversely, the top five importing countries were the USA, Japan, Germany, the United Kingdom, and France [7]. The majority of exporting countries involved in the trade of ornamental fish are in developing countries in Asia, such as Singapore, Thailand, Indonesia and the Philippines, with over 80% of the trade involving exports from the Philippines and Indonesia to the USA [1], [8]. The economic disparity between the importing and exporting countries creates many imbalances in the trade, which can in turn lead to social, environmental and economic ramifications that are generally shouldered by the poorer exporting countries.

Approximately 1 billion ornamental fish are exported annually, with the trade involving more than 1000 species [7]. In the case of Australia alone, 8-10 million ornamental fish are imported each year [9]. Of all the ornamental fish and invertebrates imported into the European Union in 1998, 37% were tropical freshwater fish, 28% were cold water fish,

16% were marine fish, 8% were corals and 11% were other invertebrates [8]. The majority of ornamental fish traded are freshwater and farm-bred, whereas marine ornamental fish species and invertebrates are mainly wild-caught [7]. Aquarium animals are the highest value-added product harvested from coral reefs, with aquarium fish selling for an average of $248 per pound compared to food fish at an average of $3 per pound [10].

III. Environmental Problems Associated with the Trade

The extractive nature of fish collecting, which often occurs in developing countries that lack adequate resources and mechanisms for reef conservation, has serious impacts upon the fragile coral reef ecosystems in which it occurs. The ecosystems of coral reefs are among the "most diverse and valuable ecosystems on earth" [2], supporting one million species of animals and plants and an estimated eight million species that are yet to be discovered [2]. However, studies have found that 25% of coral reefs around the world have already died or are severely damaged, and a further 30% are under serious threat [11]. Overfishing, global warming, destructive fishing practices and coastal development represent the major threats to coral reefs [11]. For example, in Honaunau, Hawaii, abundance of the top ten aquarium fish species has decreased by 59% over the last 20 years [2]. In particular, the international trade of ornamental fish impacts upon reefs through overfishing and the use of destructive fishing practices such as cyanide poisoning and explosives [2]. It is estimated that, since the 1960's, more than one million kilograms of cyanide have been used on Philippine reefs alone [2]. In addition to this, the marine ornamental trade often targets rare fish and coral species, which fetch the highest prices, placing additional pressure on these species and their survival [2]. The fact that the trade is also highly mobile is another characteristic that is conducive to environmental degradation, in that, as soon as stocks are depleted in one area, collectors move to another area to inflict similar damage. This means that the trade ultimately disadvantages the environment and the communities where fish collecting occurs, with little incentive present for the long-term sustainable use of the environment and its resources by a community, and few benefits passed onto local communities [2]. The majority of exporting countries (where fish collecting occurs) are developing countries, which often lack the "institutional or financial capacity or political will" to mitigate the damage to coral reefs that occurs as a result of fish collecting [2]. Therefore, the international community is ultimately left responsible to generate resources and cooperation and monitor the trade in order to protect the coral reefs from which ornamental fish are extracted [2].

IV. Economic Problems Associated with the Trade

The imbalance between importing and exporting countries in the ornamental fish trade also reflects itself in the inequitable profit distribution between importers and exporters, with the benefits of the trade predominantly favoring the importers. This is due to the fact that the importing countries generally have a buying power that dwarfs the financial resources of the fish collectors in developing countries, and so are largely the ones who control the economics of the market [8]. This is illustrated by the guide below, which dictates the pricing of marine ornamental fish [12]:

-Cost of fish to importer (landed cost) = export price (free on board) + freight and insurance.
-Wholesale price = landed cost x 2.
-Retail price = wholesale price x 2.

This is again proven by the specific example of the collection of a single Naso Tang (*Acanthuridae*) in the Philippines [13]:

A collector gets:	US$0.26
The exporter price is:	US$2.50
The shipping cost* is approximately:	US$9.00
The retail price is approximately:	US$53.00

*to the USA/Canada

TABLE I: Prices Paid to Collectors for Ornamental Fish along the Marketing Chain

	Paid to collector		
Species	Middle-man	Non-certified exporter	Certified exporter
Banded coral shrimp	0.02	0.05	0.05
Domino damsel	0.03	0.05	0.05
Percula clown	0.06	0.14	0.23
Spotted grunt	0.06	0.12	0.13
Chelmon butterfly	0.06	0.12	0.18

Source: [1] C. S. Shuman, G. Hodgson and R. F. Ambrose. (March 2004).

TABLE II: Prices Charged by Sellers for Ornamental Fish along the Marketing Chain

	Charged by seller		
Species	Exporter	Whole-saler	Retailer
Banded coral shrimp	0.62	N/A	7.00
Domino damsel	0.28	1.45	2.00
Percula clown	0.77	7.95	12.00
Spotted grunt	1.50	8.95	15.00
Chelmon butterfly	1.40	8.95	15.00

Source: [1] C. S. Shuman, G. Hodgson and R. F. Ambrose. (March 2004).

TABLE I shows the prices paid (US$) to collectors by middlemen and exporters along with the proposed prices to be paid for certified fish (by a certified exporter) in the Philippines [1]. Table II demonstrates the prices charged for ornamental fish by exporters, wholesalers and retailers [1].

In the Philippines in 1997, there were 3500-4000 individual fish collectors who produced a total export value of US$8.5 million [8]. However, each individual collector only received approximately US$17.50 as a monthly wage [8]. These problems often arise because the actions of the collectors, who generally come from small countries and therefore small economies, have negligible effect on world markets. Therefore, they are said to be "price-takers" in the

world economy and cannot affect the world price (the price prevailing in world markets) of marine ornamental fish [14]. In addition to this, the social cost faced by ornamental fish collectors due to the low price they are paid for the fish they collect and the negative externalities caused by collection (e.g. localized reef destruction and biodiversity loss), is much greater than the price paid for the fish by consumers in importing countries [14]. A vicious circle is thus created, whereby low prices entice collectors to increase their catch, often by using unsustainable or harmful fishing methods, ultimately causing long-term damage to the environment and the industry [8].

V. Eco-Certification

There is an "urgent need to develop positive trade regimes" [2] to improve the sustainability of the ornamental fish trade by enforcing import bans on organisms that are caught on reefs without sustainable management plans. This is designed to ensure that consumer demand does not exacerbate the degradation of coral reefs. The recent spur in "green consumerism" has involved greater consumer preferences for companies and products with minimal environmental impacts [15]. Thus the new strategy to achieve ocean conservation is through consumer markets [16]. The main tool to achieve this is through the use of certification programs, which utilize the consumer market for the conservation of coral reefs [16]. Eco-certification programs influence consumers to reduce the environmental impacts of their consumption by purchasing only those products that are produced and distributed in an environmentally friendly manner [17]. Three main benefits of the use of eco-labeling in fisheries are the promotion of consumer choice, improvements in economic efficiency and the enhancement of market development [18]. The short history of the use of eco-certification as a management tool for fisheries gained momentum in 1996 through the development of the Marine Stewardship Council (MSC) [19]. The MSC was developed with the focus of global certification of the sustainable performance of fisheries [19]. The system encompasses any organization that processes, wholesales or retails the certified product [19]. Despite initially poor reception for the MSC, the system is now expanding and garnering increased support from fishing-related industries, governments and NGO's as a tool to achieve increased sustainability in fisheries [19]. Major fisheries are now signing up to the MSC certification program at an accelerating rate [19]. This growth reflects the increasing consumer acceptance of the MSC certification system. However, ongoing challenges faced by the MSC include maintaining consistency, effective management, stakeholder involvement, accountability and efficiency [19].

VI. MAC Certification

Long term economic benefits can only be obtained from marine resources, such as ornamental fish, if responsible harvesting and handling are ensured in order to minimize both overfishing and damage to coral reefs. With these goals in mind, the Marine Aquarium Council (MAC) initiated a certification program publicized as a means to promote the sustainability of marine ornamental fish populations and the coral reef ecosystems through market mechanisms [2]. These mechanisms involve allowing consumers to recognize and support responsible collectors by selectively purchasing from them [10]. The presence of MAC certification labels on retailed marine ornamentals targets the purchasing power of consumers by ensuring the quality and sustainability of traded organisms [10]. E.O. Wilson described such a system as seeking to "give the invisible hand of free market economics a green thumb" [20]. The third-party certification system developed by MAC provides internationally approved standards for the trade in marine ornamental fish to ensure the continuing health of marine ornamentals and their habitats. By minimizing environmental destruction and promoting conservation and sustainable use within the industry, MAC also hopes to provide for the continuing livelihoods and reduction of poverty for rural villagers in developing countries from which ornamental fish are exported. The MAC certification system seeks to achieve these goals by utilizing market forces in the developed countries that import ornamental fish. It is hoped that increased publicity surrounding MAC certification will motivate consumers to prefer MAC certified organisms over lower quality, uncertified organisms [10]. The certification system was developed in 2001 and the first certifications were awarded in 2002 [21]. MAC certification is currently the only certification system that applies specifically to the trade in marine ornamental fish. The only other agreement that monitors the trade is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This convention is a legally binding international agreement that regulates the international trade in threatened organisms. However, currently, CITES does not affect domestic trade and only applies to hard corals, seahorses, giant clams and live rock, limiting its effectiveness in ensuring the sustainability of the trade [22].

The three areas that MAC certification encompasses are ecosystem and fisheries management; collection, fishing and holding; and handling, husbandry and transport. Ecosystem and fisheries management refers to MAC's intention to ensure habitat, stock and species management and conservation in collection areas by validating that management is conducted according to sustainable principles. Collection, fishing and holding refers to the handling, holding, packaging and transport of organisms that occurs prior to export. In order to gain MAC certification, these processes must be conducted in such a manner as to ensure the health of the organism and the environment. MAC certification also monitors all handling, husbandry and transport that occur along the commercialization chain. A certified product must pass from one MAC certified industry operator to another along the entire length of the chain [21]. Paul Holthus, executive director of MAC, stated that, whereas currently it is not uncommon for 15-20% of marine ornamentals in each shipment to be dead upon arrival, MAC guidelines allow a maximum of only 1% dead on arrival and 1% dead after arrival for each link in the industry supply chain [23].

VII. The Economics of MAC Certification

MAC certification covers all elements of the marketing chain, including collection areas, collectors, exporters, importers and retailers [10], [21]. Certified parties can display a MAC certification label advertising the assessed sustainability of the traded organism [21]. In endorsing MAC certification as a solution to the inherent problems of the marine ornamental trade, it has been claimed that the economic benefits of the system will spread from consumers and retailers to collectors. Specifically, the guaranteed quality of certified fish is hoped to result in greater profits for collectors by improving market access and bargaining power [10]. This in turn has the potential to reduce the incentive for overexploitation and use of destructive fishing practices [1].

In one case, an aquarium fish collector in the Philippines who would previously have received US$0.75 for a common tomato clownfish (that would most likely have been caught using cyanide) now receives US$2.50 for the same fish, all due to his recent MAC accreditation [10]. At the other end of the marketing chain, consumers may also receive financial benefits through the certification system, as the certified organisms they purchase are of a higher quality and so may live longer [1]. One ornamental fish retailer stated that the quality ensured by MAC certification provided a "competitive edge" for his business [10]. Another retailer stated that the higher quality of the fish resulted in lower fish mortality, making fish-keeping easier and attracting more people to the hobby, which is often perceived as difficult [10]. An additional aspect of MAC certification is its role in increasing the value of ornamental fish, enabling retailers to consider them as precious, rather than disposable, ultimately resulting in more responsible fish-keeping [10].

VIII. Problems Faced by the MAC Certification System

The main challenge to the success of the MAC certification system is garnering enough support for the system and its role in ensuring sustainability in order to influence consumers to be willing to pay more for certified organisms. Considering that the majority of exporting nations are developing countries and lack sufficient resources to implement MAC certification, funding for the enforcement of the system is generated via tariffs placed on imported organisms, which are directed to the wealthier importing nations [1]. It is hoped that such tariffs will also provide additional input into local communities in the exporting nations [1]. Whereas these tariffs are an effective way to ensure continuous funding for the system, they result in uncertified, cheaply collected organisms costing less than certified organisms [2].

Therefore, MAC certification must overcome the market economics of the trade in order to influence consumers to prefer certified organisms. Whereas some studies have demonstrated that consumers would indeed be willing to pay more for a certified organism caught in an environmentally friendly manner, detailed economic analyses and surveys of consumers' willingness-to-pay for certified organisms will need to be undertaken to determine how the certification program will be received by consumers [1], [16]. This paper will examine the findings of three studies which analyze the receptivity of consumers to MAC certification. In doing so, this paper will also discuss whether MAC certification is an effective way to maximize the economic benefits of the ornamental fish industry and minimize the environmental damage by influencing consumer choice. It is hypothesized that MAC certification will indeed provide economic benefits, both through reduced losses and mortality of fish and due to consumer perceptions that MAC certified fish have "increased value relative to uncertified competitors" [24].

IX. Study: Spruill and Dropkin (2001)

This study, conducted in 2001 by the organization SeaWeb, involved an informal survey of 77 aquarium hobbyists attending a conference of the Marine Aquarium Societies of America [16]. The findings of this study suggest great receptivity among aquarium hobbyists to a program such as MAC certification. The survey found that large numbers of participants were willing to modify their purchasing behavior to help the oceans and promote sustainability. Most individuals surveyed stated that they wanted to support an industry based on quality and sustainability. Some were very interested in where the fish they purchased came from and the manner in which they were collected. Generally, the individuals surveyed were willing to pay more for MAC certified fish that were classified as sustainable in both collection and handling.

X. Study: MAC (2002)

In 2002, MAC conducted a case study of four firms to determine the costs and benefits of MAC certification to the US marine aquarium retail. MAC found that the certification system had economic benefits for retailers due to the lower mortality rates of certified fish. However, the stores examined in this study did not charge price premiums for MAC certified specimens, so the findings do not take into account the effect of the higher prices of certified fish on consumer choice [21].

XI. Study: Alencastro *et al.* (2005)

In this study, a survey of marine aquaria hobbyists was conducted [21]. The focus of this survey was to analyze the importance of product attributes of marine ornamental fish on consumer choice. Such product attributes included the price of the fish, whether it was eco-labeled, a post-purchase survival guarantee and whether the fish was wild-caught or cultured. The survey consisted of two scenarios: the first involving a high value specimen, the blue-faced angelfish, and the second involving a cheaper specimen, the maroon clownfish. Both species are considered popular with hobbyists and are collected from areas that have experienced certain degrees of environmental damage (named in the survey as the Philippines and Indonesia). Firstly, the factors that had an effect on consumer choice were determined through the use of statistical models. These models were then applied to the specific examples of the angel fish and

clownfish to determine how likely a fish with specific characteristics would be purchased.

The majority of participants surveyed were males aged between 24 and 44, with above-average levels of education and annual income. The vast majority of participants indicated that they highly valued the conservation of coral reefs and wild stocks. Most of the participants appeared to be avid hobbyists, demonstrating high level of involvement and knowledge within their hobby. For example, approximately 80% stated that keeping marine ornamental fish was their main hobby, 59% were members of an aquarium society, 88% had researched the specimens they keep and more than 60% had paid more than US$50 for a single fish. However, the survey found that approximately 50% were not familiar with the MAC certification system. The findings of the survey suggest that price was a relatively unimportant factor affecting consumer choice in the retail of ornamental fish. In fact, the survey interestingly found that price was positively related to increases in purchase, meaning that participants were more likely to buy more expensive fish. This may be due to the fact that more expensive fish may be viewed as being of higher quality. Cultured fish and those with an extended life warranty were found to influence consumer choice to a similar degree as MAC certification. Contrary to expectations, the survey found that MAC certification had weak or even negative effects on consumer choice, especially among those participants claiming to be familiar with the certification system. Such negative perception of the system was again highlighted by participant comments which revealed that they believed the MAC certification system lacked credibility. They also indicated that they believed that cultured ornamental fish were the most sustainable purchase option and posed the smallest threat to the environment.

In regards to the scenario involving the maroon clownfish, cultured fish had a much greater probability of purchase than wild caught fish, not taking into consideration whether the fish was MAC certified. However, participants generally preferred uncertified fish, perhaps perceiving cultured fish as an equally sustainable substitute for MAC certified fish of the same species. If the fish was described as wild-caught, individuals were more willing to pay higher prices for MAC certification. This is as expected, with the individuals, who indicated concern for environmental conservation, perhaps perceiving the higher prices associated with MAC certification as being indicative of greater environmental sustainability. However, such willingness to pay for MAC certification was less evident if the fish was cultured, perhaps because the participants saw certification as unnecessary if the fish was not extracted from the marine ecosystem and so would have no environmental impacts.

The hypothetical scenario involving the blue-faced angelfish demonstrated that the influence of a post-purchase survival guarantee on purchase decisions for wild-caught fish was greater than the effect of MAC certification. Again, price was found to be a relatively unimportant characteristic, especially compared to the characteristics that promoted environmental sustainability.

While the survey indicated that the MAC certification system was generally negatively received amongst the hobbyists surveyed, it also found that the participants who were more familiar with the association of the prevention of coral reef and ecosystem damage with MAC certification showed a preference for MAC certified fish. This indicates that marine ecosystem protection greatly influences consumer choice for marine ornamental fish among the hobbyists surveyed. This in turn demonstrates potential for eco-certification systems promoting the environmental sustainability of traded marine ornamentals. The findings of the survey also suggest that making more hobbyists aware of MAC certification and its role and credibility in improving the sustainability of the ornamental fish trade may influence more hobbyists to prefer MAC certified fish over other purchase options. This is especially required since only 50% of respondents had some level of familiarity with MAC. Additionally, considering that only a relatively small number of hobbyists were surveyed, these results may not be accurately indicative of the entire population of marine ornamental hobbyists.

XII. Conclusion

The trade of ornamental fish and aquarium supplies spans the globe, with a total global retail value of approximately US$500 million. However, the environmental impacts of the trade and the economic disparity between the importing and exporting countries can have social, environmental and economic ramifications for the poorer exporting countries. The certification program initiated by the Marine Aquarium Council (MAC) is a means to promote the sustainability of marine ornamental fish populations and coral reef ecosystems through market mechanisms. This involves allowing consumers to recognize and support responsible collectors by selectively purchasing from them. It has been claimed that the economic benefits of the system will spread throughout the entire marketing chain. However, MAC certification must overcome the market economics of the trade in order to influence consumers to prefer certified organisms. That is, consumers must be willing to pay more for certified organisms collected in an environmentally friendly manner. Studies of consumers' willingness to pay and the potential economic benefits of MAC certification have shown that further promotion of MAC certification and its role in ensuring environmental sustainability is required to ensure the competitiveness of MAC certified fish with cheaper alternatives.

The findings of the three studies examined have somewhat heterogeneous verdicts on the success of the MAC certification system. However, the findings of the three studies are common in that they indicate definite potential for the continuing development of eco-certification within the ornamental fish trade. This is evident through the high priority given to environmental sustainability and product quality by retailers and consumers alike. Considering that the role of the consumer is central to the success of eco-labeling, such potential can only be realized if consumer trust and awareness within the certification system are established [19]. Areas of development to continue furthering the certification system include appropriate promotion of the label, transparency of the standards and assessment process of the system and the provision of incentives for fisheries actors to

seek certification [18], [25]. Ultimately, the success or failure of MAC certification depends on whether the system can overcome the economics of the market; in particular, ensuring the competitiveness of MAC certified fish with potentially cheaper alternatives [24]. One way in which this could be achieved is to attempt to narrow the price gap between certified and non-certified fish. However considering this, it is also desirable to increase consumer willingness to pay premium prices for certified fish. In conclusion, it is imperative for any ornamental fish trade to be supported by a comprehensive stock assessment program in order to ensure the continuing sustainability of ornamental fish stocks.

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