



Consumer perspectives on the “web of causality” within the marine aquarium fish trade

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Abstract

Collection, handling and transportation issues surrounding the marine aquarium fish trade have resulted in the degradation of many fishing communities and coral reefs worldwide. Currently, a number of conservation organisations are working in source countries to improve industry sustainability. An analysis of United States consumer perspectives on the marine aquarium fish trade suggests that additional attention to informing consumers and hobbyists is fundamental in creating the demand for sustainably caught organisms. In addition, such educational campaigns should link human health impacts for collectors with environmental ones in a manner that is appropriately honest, yet not antagonistic to this important industry. Content analysis of various US-based aquarium hobbyist resources and interviews suggests that the public discourse surrounding the negative environmental and human health issues of the aquarium fish trade is not well developed. Very little information on the processes involved in collection is readily available to the concerned aquarist or general public. Not surprisingly, hobbyist media generally avoid these challenging topics. As might be expected, trade books and magazines generally stress that the aquarium industry inspires its hobbyists to be conservationists. A recent expansion of online aquarium fish retailers has made it easier for hobbyists to make impulsive purchases with little knowledge on where the organisms were obtained, what condition they will arrive in, or the suitability of the organisms for their current aquarium systems. Websites occasionally offer “hand-caught” livestock, but with no definition of what “hand-caught” actually means, or it is specified that their organisms were not harvested from areas of common cyanide usage (i.e. Indonesia or the Philippines). The linkages between various stakeholders associated with the aquarium fish trade are summarised here in a “web of causality”. This analysis suggests that a holistic strategy addressing various unsustainable processes is fundamental to success.

Introduction

The use of cyanide as a means of collection in the marine aquarium fish trade poses a great threat to the health of already endangered coral reef ecosystems across the Indo-Pacific region. However, the aquarium fish trade alone is not responsible for the majority of the ecosystem degradation in this region, nor is stopping the use of cyanide likely to do more than slow the current rate of destruction. Additional threats, such as the removal of mangrove habitat for coastal development, urban pollution, blast fishing and increased sedimentation as a result of ongoing deforestation, among others, pose a danger perhaps greater than cyanide fishing. These issues must all be addressed in order to slow, if not stop, the current rapid rate of coral reef destruction. And to ensure the sustainability of any success that might be obtained, the complex root causes of these problems must also be addressed. In order to fully understand why cyanide is used in the Indo-Pacific

region, we need to expand our focus to look not just at the collection countries, but also at the importing countries and the consumer pressures that often reinforce its use.

In this paper the term “aquarium trade” refers to the chain of custody in which pet aquarium fish are provided to the consumer. The terms “aquarium fish,” “marine ornamental,” and “ornamental” are used interchangeably throughout this paper and all refer to marine organisms that enter the aquarium trade. This study looks specifically at the trade of ornamental finfish harvested from coral reefs in the Philippines, although some findings are applicable to corals and other invertebrates. It is important to note, however, that organisms for the trade are collected in waters throughout the tropics (Barber and Pratt 1998; Sadovy and Vincent 2002; Wabritz et al. 2003).

This study examines what is important to American consumers — who dominate the global market

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for aquarium fish — concerning where and how their aquarium fish are acquired, what aspects of the trade are commonly understood by consumers, and what influence additional knowledge about the environmental and human health impacts of collection procedures would have on the choices consumers make at the time of purchase.

The aquarium fish industry has promoted a hobby of growing popularity in the United States as advances in aquarium technology have opened the market to a larger proportion of potential hobbyists. Increasing success in the maintenance of private aquarium systems, in conjunction with the growing popularity of the aquarium-keeping hobby, due in part to the popular media, have increased the demand for aquarium fish, which are widely available in retail stores as well as on the Internet. Large chain stores have begun carrying simple aquarium supplies and livestock with the hopes of cashing in on this increased popularity.

With growing concerns about the health of the world's oceans, several media sources have increased the frequency at which issues related to sustainable fisheries and coral reef decline are discussed. The release of the Disney/Pixar animated film "Finding Nemo" spurred a flurry of interest in the environmental impacts of the aquarium fish trade (Moss pers. comm. 2005). Television appearances of the actor that played the voice of Nemo, along with magazine and newspaper articles across the US, have increased consumer demand for "Nemo-styled" tanks while promoting awareness about the manner in which ornamental organisms are collected. Similar to the impact of the film "101 Dalmatians" on consumer demand for pet Dalmatian dogs, "Finding Nemo" has greatly increased demand for ornamental fish, leading to the coining of the term in the pet industry, the "Nemo Effect" (Jackson et al. 2003). Along with issues related to releasing non-native species into public waterways (flushing unwanted pets down the drain or releasing them directly into rivers or lakes), recent television programs and articles have focused on collection practices in the Indo-Pacific region. International non-governmental organisations (NGOs) have teamed up with the media to increase consumer awareness about these issues. That increased awareness, however, has not extended to the negative health impacts of the trade on collectors. Scholarly articles mention this issue in passing or in reference to the live food fish trade (e.g. Johannes and Riepen 1995; Barber and Pratt 1998), but there is rarely any critical dialog surrounding these health impacts.

Background

The marine aquarium trade is extremely dynamic and widespread, providing income for millions of people worldwide both in the fishery sector and in

accessories retail and maintenance. While marine ornamental organisms are often the most profitable resource harvested from coral reefs, current collection practices have extensively damaged habitat and fish stocks internationally (Wabritz et al. 2003).

Up to 98% of all aquarium fish are believed to be wild-caught (Wood 2001). The majority are harvested from the Indo-Pacific, which is known as the centre of coral reef biodiversity (Johannes and Riepen 1995; Barber and Pratt 1998; Wood 2001; Sadovy and Vincent 2002; Wabritz et al. 2003). Centres of export are concentrated in Indonesia and the Philippines. Major importing countries are the US, United Kingdom, Taiwan and Japan, although the latter two are generally not the final destination (Wabritz et al. 2003). The US dominates the market, receiving approximately 60% of the world's catch (Baquero 1999).

It is estimated that of the 86 million American households, 11% have aquariums, although 90% of the 12 million aquariums contain only freshwater fish (NFO Research, Inc. 1992, as cited in Waltonne 1994). Aquarists spend an average of 200 US dollars (USD) annually on livestock and supplies (Baquero 1999). The majority of fish tank owners maintain "fish tank" style aquariums with fish as the only inhabitants due to ease of maintenance and lower cost. Advances in technology have opened the market for increasing demand for "mini reef" style aquariums, which tend to include coral, live rock and other invertebrates (Baquero 1999).

Collection

Fishers work alone, in family or small community groups, or for various fishing companies (Wabritz et al. 2003). Employed fishers may be salaried or paid by the piece (Baquero 1999). Common collection methods include mist nets, hand nets, drop nets, hook-and-line, specialized spears, slurp guns, tickle sticks, muro-ami, poisons, and a variety of specialised and traditional methods (Halim 2002; Tissot and Hallacher 2003; Wabritz et al. 2003; Lunn and Moreau 2004; Sadovy pers. comm. 2005).

Nets, slurp guns and tickle sticks tend to be the least damaging to the environment. In a study of fishing methods used at Malalison Island, Philippines, nets appeared to bring the greatest net income to fishers, followed by hook-and-line, due to ease of operation and low initial cost to the fisher (Smith et al. 1980; Amar et al. 1996). Nets are generally considered a sustainable method; however, nets can snag on corals, causing damage if the fisher is not careful (Tissot and Hallacher 2003). Further, improper use may damage the collected organisms, making them unfit for export (Robinson pers. comm. 2006; Cruz pers. comm. 2006; Green pers. comm. 2006). Slurp guns use suction from a pressurized chamber

to catch the desired organism (Sadovy pers. comm. 2005). The use of tickle sticks involves the fisher chasing the fish into a crevice, placing a net over the entrance, and using a stick to “tickle” the fish out of the crevice and into the net (Wabritz et al. 2003). Muro-ami involves placing a net over a section of reef and bouncing tethered rocks off the coral in order to scare the fish into the net (Mitchell 2002; Christie pers. comm. 2005–2006). Variations on this method include beating the coral with sticks rather than rocks, or using hookah pipes to bubble water into the coral crevices to scare the fish out, the latter being much less damaging (Wabritz et al. 2003; Sadovy pers. comm. 2005).

Most ornamentals caught in deeper waters require long dives, for which fishers use scuba or surface-supplied pressurized air with devices known as “hookah” (Wabritz et al. 2003; Wood 2001). Due to the shallow habitat of many desirable species, several marine ornamentals are also caught while free-diving (Sadovy pers. comm. 2005). Common poisons used are sodium cyanide, potassium cyanide, bleach, and quinaldine (Barber and Pratt 1998; Tissot and Hallacher 2003; Wabritz et al. 2003). Poisons are typically mixed with seawater in a squirt bottle and the hookah or scuba diver squirts the solution into a coral head. The poison stuns all the fish that come into contact with it, making them easier to collect. The stunned fish often take refuge inside a crevice before the poison takes effect, in which case the fisher may use a crowbar to pry apart the coral. If the diver is free-diving, larger amounts of poison are typically dumped from a boat over large areas of reef in order to save time collecting underwater (Barber and Pratt 1998). Fish are believed to metabolize and excrete cyanide rapidly; however, due to their weakened state, fish caught with cyanide are more likely to die due to the stress of transportation and handling (Barber and Pratt 1998; Baquero 1999; Wabritz et al. 2003).

Independent fishers, using their own boats, often stay close to shore, making daily fishing trips (Lunn and Moreau 2004). Employed fishers or staff collectors may use boats supplied by the employer and often make multiple-day fishing trips (Lunn and Moreau 2004). Local governments and employers often require staff collectors to be trained in what species are most desirable and in collection methods that result in less harm to the species and environment (Barber and Pratt 1998; Baquero 1999). However, this is not always the case, as some employers actually supply the poison and require the fishers to use it (Johannes and Riepen 1995; Cruz pers. comm. 2006; Christie pers. comm. 2006). Staff collectors often work long hours under dangerous conditions, with little or no knowledge of diving safety (Johannes and Riepen 1995; Barber and Pratt 1998; Jacques 2001; Halim 2002; Sadovy pers. comm. 2005; Christie pers. comm. 2006).

Handling and transport

Generally, immediately following collection, ornamentals are stored in containers of seawater for transportation to a holding facility (Wabritz et al. 2003). Temporary holding facilities are often in the house of the collector until picked up by or delivered to the first buyer (Sadovy pers. comm. 2005). Once delivered, the fish are generally quarantined without food for a minimum of 48 hours in order to prevent them from excreting in their transport bags (Baquero 1999; Wabritz et al. 2003). Fish excretions contain ammonia and can be fatal in high concentrations (Baquero 1999). The exporter or transporter will then acclimatize the ornamentals for transport (Albaladejo and Corpuz 1981; Wabritz et al. 2003). Typically, fish are placed in a plastic bag filled with two parts oxygen to one part seawater (Wabritz et al. 2003). In general, the smallest bag possible is used in order to cut back on shipping weight and volume (Baquero 1999). Some exporters and transporters will add an antibacterial and water sterilizer before sealing the bag (Baquero 1999). The bags are then packed into insulated cardboard boxes for shipment (Albaladejo and Corpuz 1981; Baquero 1999; Wabritz et al. 2003). Shipments are often required to be accompanied by a veterinary clearance; however policies and practices differ among exporting countries (Wabritz et al. 2003).

Importers sell the ornamentals to a wholesaler or a retailer, or re-export them (Wabritz et al. 2003). Aquarium owners, which include hobbyists and public aquariums, buy from retailers or occasionally directly from wholesalers (Wabritz et al. 2003; Sadovy pers. comm. 2005). Internet stores have made the retailing process easier for consumers.

Cyanide fishing

The use of cyanide as a fishing technique was first documented in the Philippines in 1962 (Wabritz et al. 2003). More than 150,000 kg of cyanide is believed to be used in the Philippines annually in the collection of marine ornamentals and more than 1 million kg have been used since the 1960s (Pratt 1996; Barber and Pratt 1998). Cyanide has been demonstrated to cause mortality in laboratory corals; however, these findings are difficult to interpret with respect to the effects of cyanide on wild populations of corals (Jones and Stevens 1997). The use of cyanide is also known to produce high mortality in non-target organisms, such as invertebrates that might be in the surrounding area when cyanide is used (Baquero 1999). Local fishermen and dive operators, however, have no doubt about its detrimental effects (Barber and Pratt 1998). Recent studies have shown that the combination of cyanide use and the stress caused by post-capture handling results in mortality of up to 75% of fish within 48 hours of capture (Wabritz et al. 2003; Bunting et al. 2003). With such a high mor-

tality rate, a greater number of fish must be caught in order to compensate for post-capture deaths.

Health impacts

The impacts of collection for aquarium fishers are often overlooked when compared to the environmental impacts of the trade. However, personal accounts of health conditions in fishing communities cannot overstate the importance of looking closer at these impacts (Johannes and Riepen 1995; Johannes and Djohani 1997; Jacques 2001; Sadovy pers. comm. 2005; Christie pers. comm. 2006; Reksodihardjo-Lilley pers. comm. 2006). According to these accounts, fishers in many Indo-Pacific fishing communities have little knowledge of dive safety. Frequently, air compressors used to fill tires or for paint sprayers are used with hookah or to fill scuba tanks, and a variety of non silicone-based oils, such as motor oil and coconut oil, are used in the maintenance of diving equipment (Johannes and Riepen 1995). Breathing air contaminated with these oils or without proper filtration can be fatal. Breathing these contaminants at depth increases the concentration at which they are absorbed, as a greater volume of air is inhaled per breath while at increased pressure. Safe diving practices such as slow descents and ascents and the use of safety / decompression stops are often unthought-of or considered a waste of time in such a competitive industry. Divers are often over-weighted to achieve a faster descent, and then dragged to the surface by a partner when the dive is over (Jacques 2001). As the resource is depleted, desirable species are often available only on deeper reefs, leading fishers to make deeper dives, and increasing the chances of developing decompression sickness (commonly referred to as the “bends”). It is not uncommon to hear of divers making deep dives

in rapid succession for the duration of the working day (Jacques 2001). Standard safe diving practices call for increasingly long intervals at the surface between dives in order to let the body expel the nitrogen gas that has accumulated in the tissues.

Analysis of consumer perspectives

This study posed the questions: What is the hobbyist’s responsibility to ensure industry sustainability? What is the appropriate response of a well intentioned consumer to the environmental and health related impacts of the trade? Should the consumer stop buying aquarium fish, boycott those fish collected from regions of suspected cyanide use, or seek out certified or sustainably caught organisms? Given these and other possible responses, what information is available to consumers to help them make the proper decision?

Web of causality

Inspired by the work of John Vandermeer and Ivette Perfecto (1995) on rain forest deforestation as a result of the banana trade, this analysis resulted in a model used to graphically represent the complex linkages between resources and resource users in the marine aquarium trade. According to Vandermeer and Perfecto, when “viewed as a web of causality, it is quite pointless to try to identify a single entity as the “true” cause [of deforestation]”. “The true cause is the web itself” (Vandermeer and Perfecto 1995:162). The web in Figure 1 depicts how most hobbyists would describe the structure of the aquarium industry, as determined in this study. In this model, the environmental outcome is a direct result of the fisher choosing to use destructive or non-destructive methods.

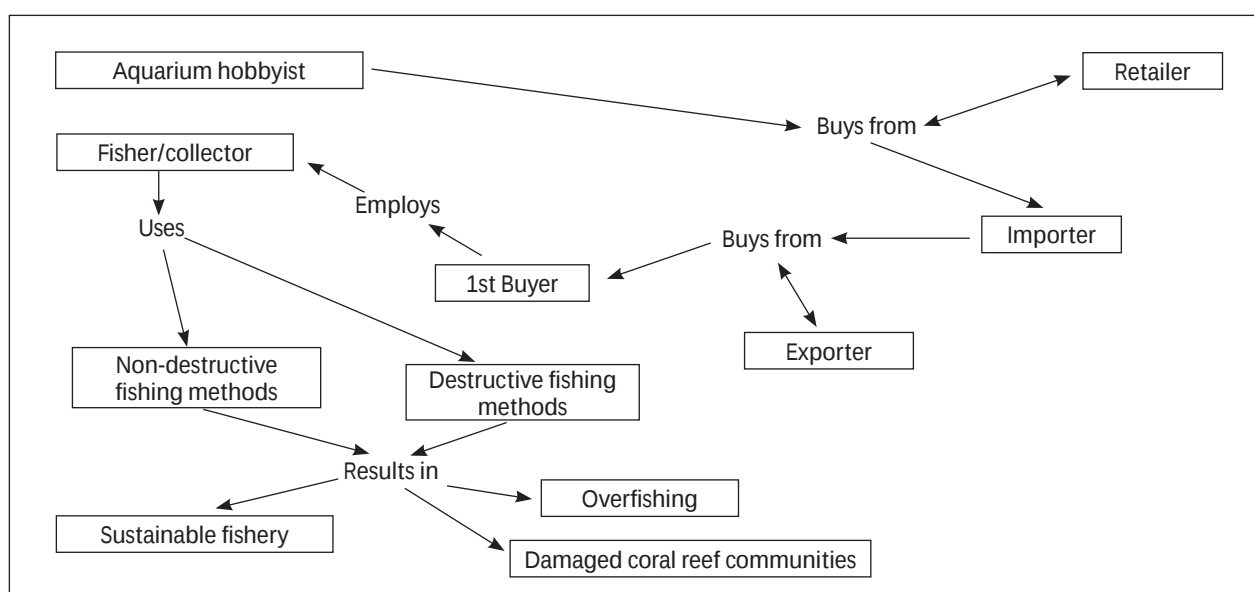


Figure 1. Web of causality for the aquarium fish trade, as perceived by hobbyists.

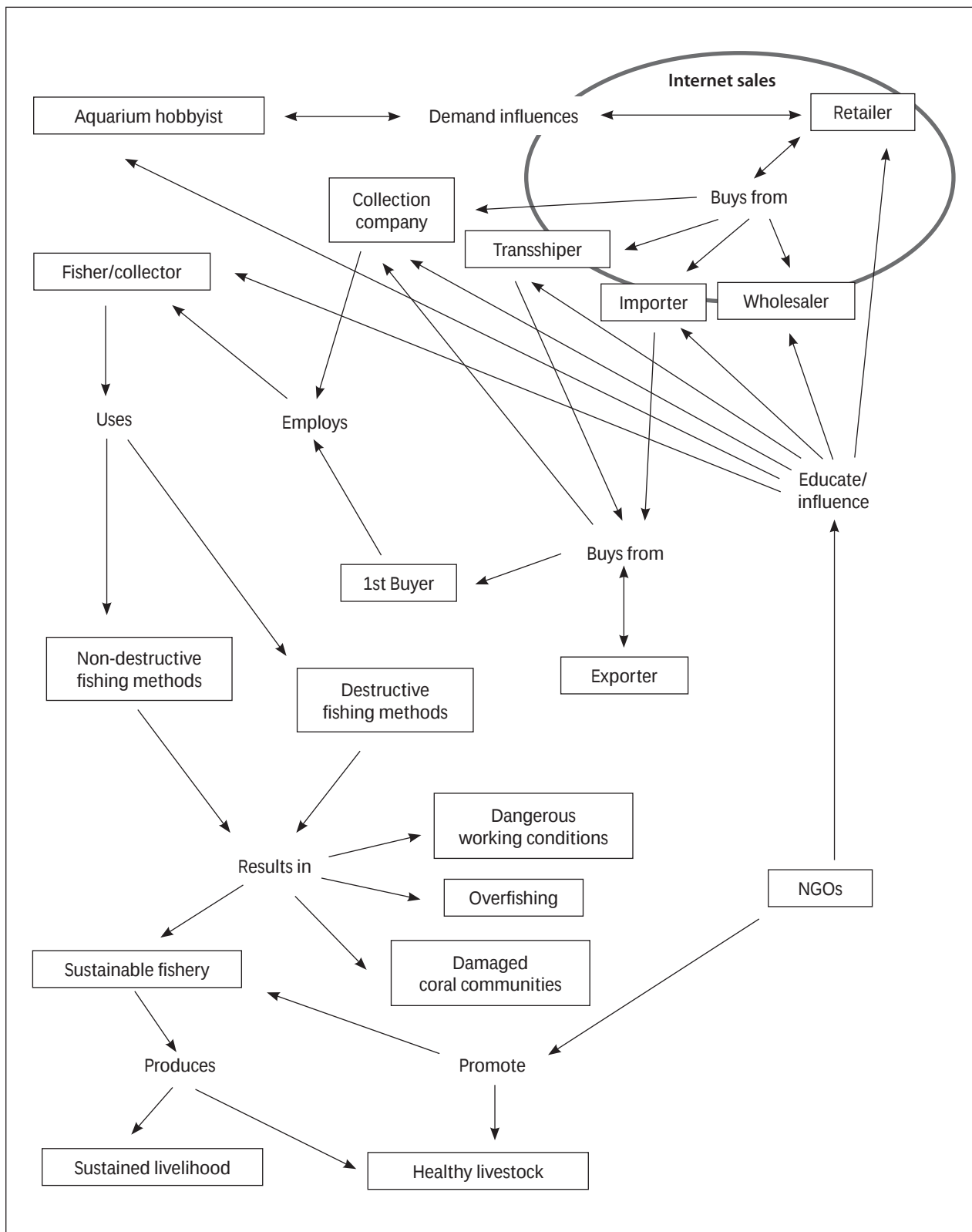


Figure 2. Expanded web of causality for the aquarium fish trade, showing the complex linkages between entities, actions and consequences.

With additional research on the complexities of the industry, the model was expanded to include several more actions and resource users along the chain of custody (Fig. 2). While this model is not by any means complete, it gives a better indication of the difficulty involved in understanding the trade from the point of the consumer. In this model, it is more difficult to place the responsibility for environmental outcomes on the fisher's decisions alone, or to identify a "true cause" for the environmental degradation resulting from the trade. Both models explain the idea that a fishing method can result in either a sustainable or unsustainable fishery. Cyanide, when used in small doses as a sort of anaesthetic, can be used as a sustainable method. On the other hand, non-destructive fishing methods, such as slurp guns, certain nets and other specialised fishing techniques, can, like destructive methods, result in overfishing.

The expanded model also captures the idea that any fishing method used can result in dangerous working conditions, as similar diving equipment is used by both net fishers and cyanide fishers. Additionally, the expanded web shows the influence that e-commerce, or online sales, can have on demand. This model points out the important fact that focusing management efforts on one or even a few of the links in the chain of custody will not solve all of the problems involved with the trade.

This study aimed at determining which issues are important to hobbyists and how a misunderstanding of the complexity of the entire trade process has compounded human health problems and environmental degradation in collection countries. The sources used to gain a better understanding of consumer perspectives were: a list of hobbyist accessible articles from 2001–2005 as supplied by

the Marine Aquarium Council (MAC) (Fig. 3 and Table 1), back issues of Freshwater and Marine Aquarium magazine, a selection of hobbyist message boards (Table 2), nine retailer websites (Table 3), and informal interviews with Puget Sound Aquarium Society members and pet store employees in the Puget Sound area and elsewhere in the US. The lack of discussion about these sources of problems faced by collectors and environmental issues prompted the development of the two "webs of causality" in Figures 1 and 2.

Hobbyist-accessible articles

MAC is an international NGO working to encourage industry sustainability by introducing a certification process for the trade that includes a labelling scheme similar to the popular "organic" and "fair trade" labels. MAC has been producing a quarterly newsletter (available both in print and online) since 2001, and most issues contain a section called "MAC in the News", which attempts to list all the news articles and other popular publications in which MAC is discussed. This list was used in this study as an index for articles likely to address environmental or human health issues associated with the trade. It was found that although several of the listed articles discussed environmental impacts, only one discussed in detail human health impacts (Jacques 2001). Figure 3 shows the number of articles that were listed in "MAC in the News" per quarter from 2001 through the beginning of 2006 (data for the 4th quarter of 2004 and 2nd quarter of 2005 are missing). The remarkable spike in the 2nd quarter of 2003 occurred simultaneously with the release in the US of the film "Finding Nemo", which created a great deal of interest in the aquarium trade. Table 1 shows the publications in which the listed articles appeared.

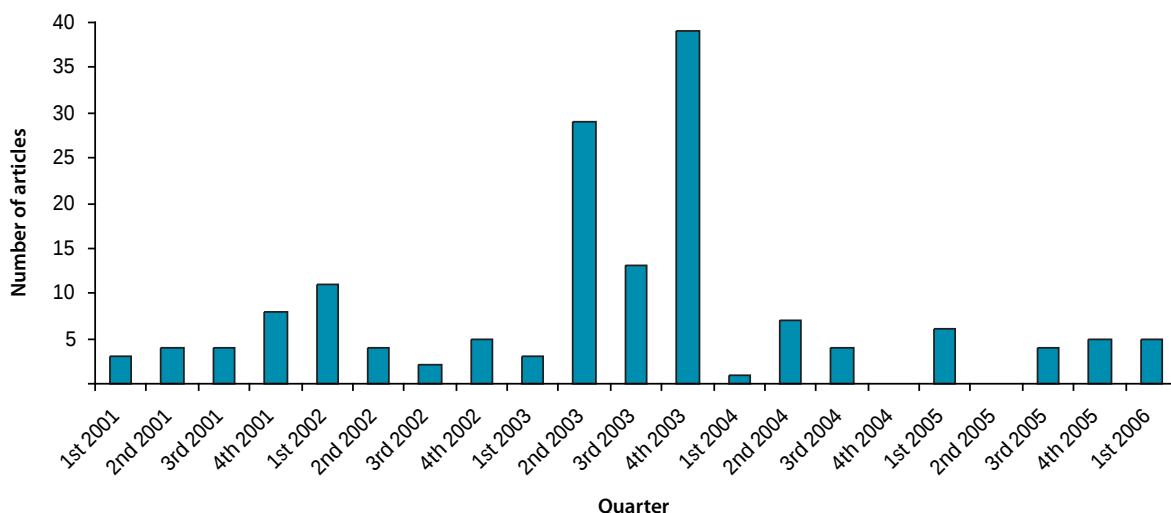


Figure 3. Number of hobbyist-accessible articles listed in "MAC in the News", by quarter.

Table 1. Sources of articles in which MAC is discussed, as listed in “MAC in the News”, 2001–2006.

Number of articles	Source
48	Newspaper/online articles
22	Other publications
18	Television shows
12	Ornamental Fish International
10	Pets International Magazine
7	Freshwater and Marine Aquarium
5	Pet Age
3	Aquatic Trader
3	Diver magazines
3	Radio programs
2	Advanced Aquarist's Online Magazine
2	Online fora
2	Tropical Fish
2	Aquarium Fish Magazine

Freshwater and Marine Aquarium magazine

The tables of contents and indices of Freshwater and Marine Aquarium volumes 3–29 (except issue 11 of volume 8 and issues 1, 5 and 9 of volume 13), which covered the period January 1980 through January 2006, were searched for any mention of collection issues, sustainability in the trade, environmental issues, human health issues, or cyanide use. The advertising sections were also searched for advertisements by NGOs involved in the trade. Nine articles were found that met these criteria, and no advertisements by NGOs were found. The first was an April 2001 article that described the efforts and goals of MAC as quoted from MAC's document “Core Collection and Fishing Practices International Performance Standards for the Marine Ornamental Trade”. This article briefly explains the importance of coral reefs and the threats of human activities (Sprung 2001). The next article that met the search parameters was an August 2001 article by Jeff Bernier in the “Responsible Reef Keeping” section. In this article Bernier stated that “...government agencies have been accosted with information citing the marine aquarium industry for irresponsibly damaging coral reefs” and “[the] hobby is full of conservationists intimately aware of and concerned with the welfare of coral reef habitats” (Bernier 2001:178). This article did not mention any of the other parameters. The third article, from March 2002, was also about MAC but included more details on environmentally destructive practices involved in the trade (FAMA staff 2002). The fourth article, in the October 2002

issue, was an editorial, also by Bernier. He urged hobbyists to ask questions at their local fish stores about where and how organisms were collected, and to patronize stores that offered sustainable alternatives to wild capture (Bernier 2002). This editorial took a more critical stance on the industry than his first article and warned consumers to be wary in their purchases. Bernier stated that consumers had power over what livestock was sold in the local fish stores they patronize, as well as how and where it was collected. He did not discuss the impacts of collection on collectors. The reader is left with the feeling that there are “good collectors” and “bad collectors” and that it is up to the reader to decide which ones they will support. Three of the next five articles were written as guest editorials by MAC staff or are about MAC practices but did not go into further details on any of the search parameters other than mentioning destructive fishing practices (Spalding 2002; Brandt 2003; Wedman-St. Louis 2003). The July 2005 article was written by an undergraduate student who studied the impacts of collecting for the marine aquarium trade on a small village in Costa Rica. While this article did not mention health impacts on the collectors, it did discuss their lack of ability to regulate the price they are paid for each organism (Lowenstein 2005). The final article, from October 2005, stated that “the use of cyanide present[s] an important ethical and moral issue to aquarists” and encouraged aquarists to look for and purchase MAC-certified organisms (Gosnell 2005:124). These articles succeed in introducing their readers to the issue of unsustainable collection and the certification scheme of MAC; however no article found in this search discussed the human health impacts faced by collectors.

Hobbyist message boards

Message boards are a useful Internet-based communication tool. Registered users can post messages about a given topic and other registered users can respond (generally at no charge). Many message boards can be viewed without having to register. Message board communities exist for nearly every subject matter imaginable. For aquarium hobbyists, they are useful as a means to share information about their current aquarium systems, to describe mistakes they have made in their own systems, and to ask for and receive advice. Twelve US-based aquarium hobbyist message boards were visited in December of 2005. At each message board, a search was conducted for the terms “cyanide”, “poison” and “collection”. Search results were then analysed in terms of the previously mentioned search parameters. Table 2 indicates for each message board the degree of attention paid to these issues, using the subjectively-assigned indicators “heated debate”, “moderate mention”, “little mention” and “no mention”. “Heated debate” means there were extensive,

often passionate, arguments between users on a variety of pertinent issues. “Moderate mention” means there was occasional discussion about issues related to the effects of collection on ecosystems and fishing communities. “Little mention” refers to message board communities where discussion was limited to blaming cyanide collection as a probable cause of death for organisms in seemingly perfect tank conditions or when the user thought “they had done everything right”. The message boards marked “no mention” returned no search results as of December 2005.

Table 2. Hobbyist message board search results for the terms “cyanide”, “poison” and “collection”, accessed in December 2005.

Website	Degree of attention paid
www.aquariacentral.com	moderate mention
www.saltwaterfish.com	little mention
www.reefs.org	heated debate
www.reefcentral.com	heated debate
www.aquahobby.com	little mention
www.aqualinkwebforum.com	little mention
www.marinebio.org	heated debate
www.aquatic-hobby.com	no mention
www.aquaticquotient.com	no mention
www.fishadviceforum.com	no mention
www.fishboard.net	no mention
www.fishforums.com	little mention
www.forums.fishindex.com	little mention

Retailer websites

As more and more purchases are made online, it is important to know what information is available to the customer at the point of sale. The websites examined in this study were for retailers that dealt only in Internet sales. As done for the message boards, searches were made for any information related to capture methods, cyanide, or environmental or health impacts of collection. Not surprisingly, retailers did not use the word cyanide, as indicated in Table 3. Of those retailers that referred to poisons at all, most specified that their organisms were obtained from areas that do not use “drugs”. It was not expected to find retailers discussing the negative environmental or human health impacts of the trade, and none of these retailers did on their websites. Most websites offered net-caught organisms exclusively or whenever possible, but with little or no explanation of whether this method was used

sustainably or in conjunction with cyanide. Several of these retailers indicated that they boycotted organisms collected in Indonesia or the Philippines. The retailer with the website www.fish2u.com bred many of its own organisms, but since it sold freshwater as well as marine ornamentals, it was unclear what portion, if any, of its marine products were captive-bred. The website www.saltwaterfish.com had a sponsored message board that included a brief discussion among customers of cyanide use.

Puget Sound Aquarium Society

The population of the city of Seattle, in the US Northwest, is known for its widespread environmental ethic, which might have an impact on consumer purchases. The questions posed to members of the Puget Sound Aquarium Society (PSAS) were:

- 1) What is the size and influence of the marine aquarium hobbyist community in the Seattle area?
- 2) Do most people tend to buy their ornamentals online or locally?
- 3) What qualities do you look for in a good aquarium store?
- 4) What species tend to be more popular and why?
- 5) What are the difficulties in operating a reef-style or marine tank when compared to a freshwater system?

As of November 2005, there were about 300 members on PSAS’s email list. Interviews with members revealed that they tended to favour supporting local fish stores where employees were often more knowledgeable and cared more about the survival of their livestock than some larger chains or online retailers. However, because local stores’ products could be twice as expensive as those of online retailers, more expensive livestock was often purchased online. PSAS members often made group orders online to lower shipping costs. The interviewees described a good aquarium store as one with a knowledgeable staff, a clean appearance, a practice of quarantining livestock for at least three weeks, a good supply of high-quality tank maintenance products, and reasonable prices. Unfortunately, members did not know of any one store that had all these qualities.

PSAS members tended to focus on reef-style tanks, involving mainly corals and functional livestock, such as a variety of algae grazers and other cleaning fish and invertebrates. For fish-only tanks, livestock with interesting behaviour or appearance were preferred. Popular species were Amphiprioninae, *Zebrafish* *flavescens*, Blenniidae, *Siganus vulpinus* and Chaetodontidae. The difficulties in maintaining reef or marine tanks were found to be linked to how much effort the hobbyist wanted to put into their

Table 3. Online retailer website search results for discussion of capture methods, cyanide, and environment or health impacts of the trade.

Website	Capture method	Cyanide	Environmental/health
www.liveaquaria.com	Net-caught, farm-raised when possible	Focuses on fish from countries where drugs are not used	No mention
www.fish2u.com	Many captive-bred (possibly only freshwater stock)	No mention	No mention
www.marinedepotlive.com	Net-caught when possible	Focuses on fish from countries where drugs are not used	No mention
www.themarinecenter.com	Net caught	No mention	No mention
www.aquacon.com	No mention	No mention	No mention
www.premiumaquatics.com	Many farm-raised	No mention	No mention
www.thepetstop.com	No mention	No mention	No mention
www.saltwaterfish.com	No mention	Mention on sponsored message board, but not on retail website	No mention
www.justrarefish.com	No mention	No mention	No mention

system. Most hobbyists failed on their first attempt at a marine tank as they are “less forgiving” than freshwater systems. A lack of knowledge starting out, bad advice from shop employees, purchasing poor quality equipment as a means of saving money, and inappropriate livestock were other reasons given for a high failure rate with first-time hobbyists. The list of important factors given for a high-quality local fish store included the availability of captive-bred organisms, but there was no mention of “cyanide free” or “sustainably caught” organisms.

Local and national fish stores

My questions about fish collection procedures put to personnel at Seattle-area fish stores were met with a variety of attitudes and responses. Personnel at some stores became quite defensive when I, as a university researcher, raised these topics: I was given a phone number and referred to their head-quarter offices. Finding I was getting nowhere with this approach, I started asking questions as a concerned consumer. With this approach, retailers were more helpful and tried to educate me about making proper decisions on potential livestock (I was nearly convinced on several occasions to purchase my own reef tank). However, most employees were uncertain of where their organisms originated, as they came from wholesalers that stock ornamentals from all over the world. Livestock of the same

species, from different source countries, were often placed in the same tank. I found that at the retail point of sale it was often nearly impossible to determine the country or origin, let alone the method of collection. One retailer had a method to determine with certainty where and how their livestock was obtained: they only sold live stock collected by their own collection company unless a customer made a special order. This retailer was particularly interested in discussing the various unsustainable fishing methods with me.

Discussion

Although an estimated 85% of marine aquarium fish are caught with cyanide (Barber and Pratt 1998), the majority of retailers claim to sell only net-caught or captive-bred or captive-raised organisms (Table 3). Approximately 5% of hobbyists were, as of 2004, aware of the MAC certification scheme (Alencastro et al. 2005). Apparently there is some misinformation being presented to consumers about how their fish are collected. The information that is reaching the consumer does not appear to adequately address all of the issues involved with collection procedures and, at most, has promoted a bad image of collectors as being solely responsible for environmental damage caused by the industry. This perspective is not helpful in alleviating the adverse conditions in collection countries that commonly use destructive

fishing methods. Taking business away from these areas in the form of a retailer- or hobbyist-led boycott would potentially only worsen the conditions that exist. Collectors' incomes would be further jeopardized and they would be forced to find other means of livelihood. Available livelihoods include destructive fishing for the live reef food fish industry and coral mining for construction materials.

MAC and its labelling scheme have the potential to play a significant role in educating stakeholders at all levels of the trade. However, there are some questions among hobbyists and retailers as to the reliability of MAC standards and certifications of fish imported into the US. Some retailers have expressed concerns that wholesalers and importers mix shipments of certified fish with non-certified fish so they are never quite sure of the origins of the livestock they receive. Currently, consumers do not have many opportunities to purchase guaranteed cyanide-free livestock that provides sustainable benefits to collectors without harming the environment. Consumers can apply the pressure needed to increase the number of MAC-certified retailers, if this is indeed the solution.

Another potential solution rests with community-based organisations that are dedicated to cyanide-free collection. Organisations such as those in the Les and Serangan communities of Bali, Indonesia, where they are supported as a project of Telapak (www.telapak.org) (Ruwindrijarto pers. comm. 2006), engage in all aspects of the trade from collection to export, and ensure that fair prices are paid to collectors, and provide proper care and handling for each organism. By removing several of the links in the web of causality and relying on a cooperative system, profits are more likely to remain in the community and the organisation can be held fully responsible for the health of its fishers and the organisms it supplies. Jobs remain stable as long as they maintain the health of their coral reefs, and there are additional opportunities for women to find work in the trade.

Educational campaigns sponsored by NGOs can have a positive effect on consumers, as television programmes and magazine articles already have. Advertisements can be placed in hobbyist magazines and discussions at local club meetings and on message boards can be easily facilitated. The Internet is a powerful tool that can both influence hobbyists to buy impulsively and educate them about current issues. Retail stores cannot be expected to report on negative aspects of the industry, but as a source of information for hobbyists, they too are responsible for the choices made in their stores. The responsibility to educate consumers ultimately lies with consumers themselves. The purchase of an organism without consideration of its origin or

method of collection or the fate of the collector happens far too frequently in importing countries, and it cannot continue if the industry is to achieve sustainability.

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