INTERNATIONAL TRADE OF AQUARIUM SPECIES

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1.0 INTRODUCTION

When you walk into many offices, restaurants, and homes, you may be greeted with a beautiful salt water aquarium. The ocean's reefs are brought to life right in front of your eyes, with tropical fish swimming, coral colonies growing on rock, and anemones swaying in the artificial current. Some marine aquarium hobbyists claim that they are nature's ambassadors, spreading word about the beauty of the coral reef ecosystem and promoting conservation. But there is a dark side of the aquarium trade industry. Rather than protecting the fragile reef ecosystem, does the global trade in aquarium species harm natural reef systems, including some of its endangered inhabitants? This paper explores various economic and environmental linkages within the aquarium trade industry, including the structure of the industry, harvesting techniques, captive breeding, and the international treaty that regulates trade of endangered species. By balancing economic and ecological concerns, it is possible for the aquarium trade to proceed in a sustainable and socially responsible fashion.

2.0 CONVENTION ON INTERNATIONAL TRADE OF ENDANGERED SPECIES

The Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) regulates the trade of protected species of plants and animals between member countries, including the United States (US). Species listings within CITES are divided into three Appendices. All trade is prohibited for species threatened with extinction, which are listed in Appendix I. Appendix II allows regulated trade of species that may be vulnerable if harvested unsustainably, and Appendix III includes species that benefit from international cooperation with respect to population management (US Fish and Wildlife Service, 2003a). CITES monitors trade by issuing permits to exporters and importers, establishing export quotas for some species, inspecting shipments going through customs, and maintaining a database of species collection data (US Fish and Wildlife Service, 2003b). If a species is listed on Appendix II, trade is not illegal. Rather, the system of permits and inspections is aimed at created a sustainable level of trade, such that it does not adversely affect population levels (UNEP, 2003).

CITES is relevant to the marine aquarium trade primarily with respect to giant clams and stony corals, which are both Appendix II species (NOAA, 2004). The listing of several other marine species was discussed at the 2002 meeting of the Conference of Parties to CITES. All seahorse species were added to Appendix II as of May 2004. In addition, further studies are being undertaken regarding trade in sea cucumbers, and despite majority support, a proposal to protect a species of wrasse failed to pass in a vote taken by the Parties (US Fish and Wildlife Service, 2003c).

3.0 TRADE DATA

The reef organism trade is dominated by fish species, which account for approximately 85 percent of the total trade by value (MAC, 2004). Other traded organisms include stony corals and other invertebrates, such as clams, crab, shrimp, "soft corals", and anemones. With over 1.5 million people keeping marine aquaria in their homes or businesses, the value of the trade in these species is estimated to be between $200 and 330 million per year (UNEP, 2003).

However, trade data in aquarium species is unreliable. Some trade statistics are available through CITES permits (e.g., for corals, clams, and seahorses), but data are not generally available for non-regulated species, including fish, which account for the majority of traded specimen. A complication also arises when different units are used to report trade data. For example, if shipments are reported by weight, they will be biased by the weight of water within the container. The United Nations Environment Programme (UNEP) World Conservation Monitoring Centre, in conjunction with the Marine Aquarium Council (MAC) established a Global Marine Aquarium Database (GMAD) in 2000. Importers and exporters have propagated this database with sales information, and the UNEP is using the preliminary data to investigate trends in trade data (UNEP, 2003).

4.0 Economic Considerations

Reef exports are generally high value products. For example, in 2000, the value of 1-kilogram of reef fish harvested for food was under $10, whereas the value of the same quantity of reef fish harvested for the aquarium industry was approximately $500 (UNEP, 2003). Similarly, the value of live coral is approximately 100 times greater than the value of coral used in limestone production, as is the value of live rock exported for aquariums versus that used in local construction projects (UNEP, 2003).

As a high value product, export of marine ornamentals provides a livelihood for many low-income laborers in the south Pacific. However, the premium paid by hobbyists in the US and European Union is not equitably distributed to the local collectors and harvesters. The industry is structured such that collectors are paid for the number of specimens collected, but this payment may only be a fraction of the ultimate sale price. For example, a collector in Indonesia receives approximately $0.10 for each clownfish harvested, whereas an American consumer pays over $15 (UNEP, 2003). The wide discrepancy in price results primarily from high shipping costs due to a live specimen's unique packaging and care requirements. In addition, there are several components of the supply chain existing between the collector and consumer, including wholesalers, importers, exporters, retailers and other middlemen. In a study conducted in the Philippines, 15 percent of the price paid by exporters (before shipping) for fish specimen went to the collectors, while the remaining 85 percent was paid to middlemen (UNEP, 2003).

Although the primary goal of CITES is to protect endangered and threatened species from unsustainable harvesting techniques, there is some controversy related to the effectiveness of a trade restriction in remedying unsustainable use of the reef ecosystem. A restriction of trade may reduce the value of the commodity, leading to lower incentive to protect and conserve that commodity, and potentially greater use for other industries. For example, in the tropical timber industry, trade restrictions were implemented as a means to save tropical forests. Instead, by devaluing timber as an export, the local population did not have as great an incentive to protect the forest and resorted to burning down trees to clear the land for (more profitable) agricultural use. The unintended consequence of a trade restriction in this case appears to be more, rather than less deforestation (Karp, 2004, Barbier 1995). Applying this outcome to the aquarium trade, it is possible that restricting the trade of aquarium species may not be the most effective way to protect reef ecosystems. As described above, for example, reef fish exports for the aquarium industry are fifty times more profitable per kilogram than reef fish used as food. If trade restrictions devalue aquarium-based profits, collectors may be motivated to harvest a higher number of fish, i.e., for the reef food sector, to maintain earnings. Rather than decrease the overall fish catch, the trade regulation may lead to the unintended consequence of greater harvesting rates.

The problem of unsustainable use of the oceans reefs is likely more influenced by issues such as lack of adequate protection and property rights than by international trade. Although trade may be part of the problem, it is not the main culprit. In addition, as described above, the industry structure of several middlemen may further exacerbate the issue, as local collectors do not realize the full value of the reef ecosystem and may be less inclined to protect it. According to the principle of targeting, it would be more efficient to promote sustainable use of the reef system by direct methods, such as creating a system of property rights, encouraging local management of reefs, promoting ecotourism, and ensuring that consumers pay the full price of environmental externalities (Karp, 2004).

5.0 ENVIRONMENTAL CONSEQUENCES

The economic push to collect large numbers of specimen while minimizing collection cost and effort has led to the use of very destructive harvesting techniques. Although destructive practices have been banned in many exporting nations, lax enforcement practices have undermined efforts to move to more sustainable harvesting techniques.

Cyanide poisoning is a technique used to stun fish, thereby making them easier to catch. In the mid-1990's, approximately 90 percent of harvesting ships in Indonesia carried cyanide, and its use is also prevalent in the Philippines (UNEP, 2003). Cyanide is a non-discriminative poison, affecting non-target fish, coral reefs, and even the divers using it. Stony corals experience tissue damage and bleaching, and prolonged exposure to cyanide has been shown to lead to coral mortality and destruction of the coral reef ecosystem (UNEP, 2003). In addition, the fish captured using cyanide is much more likely to die shortly after collection (five to 75 percent die within hours of collection, an additional 20 to 50 percent die shortly after collection, and a further 30 percent die prior to export), meaning that more fish are collected to satisfy demand (UNEP, 2003). Even if the specimen survives in the hours after collection, it is more likely to die during shipment (30 percent mortality rates on arrival at retail stores) than one handled in accordance with MAC handling and husbandry standards, which specify a one percent mortality requirement (UNEP, 2003l; MAC, 2004).

Other destructive fishing techniques include the use of other chemicals in addition to cyanide, breaking corals to provide easier access to fish, and erosion and loss of habitat following live rock collection. A further stress on fish populations includes any selective fishing program that disrupts the lifecycle of that population. For example, in some species the male is selectively harvested over the female due to differences in appearance and coloring. Over time, this selective collection can have severe consequences including biased sex ratios, failure to reproduce, and even collapse of the species (UNEP, 2004). Another example of lifecycle disruption is that of the symbiotic relationship between clownfish and anemone. In a study in 1992, over-harvesting of anemones led to a measurable decline in the density of clownfish in the area. In evaluating lifecycle concerns, certain species are more vulnerable to harvesting due to factors such as habitat area, the degree of popularity among hobbyists, the length of the gestation period, and relative demand for juvenile versus full grown species (UNEP, 2004).

Positive developments have been made to curb destructive harvesting techniques. For example, the MAC has established a third-party certification system as a means to promote sustainability within the aquarium industry. MAC has instituted three standards that address management of the collection area, harvesting techniques, and handling of collected specimen (MAC, 2004). The standards are meant to cover specimen handling throughout the supply chain from "reef to retail", and include criteria such as mortality limitations, prohibition of certain fishing techniques, and best practice guidelines for collectors, importers, exporters, retailers, and middlemen (MAC, 2004). To be certified, a specimen needs to be handled by accredited operators in each stage of its transport from the ocean to the retailer. As certification grows in popularity, it is hoped that consumers will pressure retailers to carry only certified specimen, which would be a positive step toward improving the sustainability of the aquarium hobby.

6.0 CAPTIVE BREEDING

The freshwater aquarium industry farms approximately 90 percent of the fish species sold for aquarium use (UNEP, 2003). In contrast, marine species are predominantly caught in the wild. However, a glimpse into the hobbyist culture reveals that demand for farmed species exists, and people are willing to pay more for a tank-raised specimen. An informal, non-scientific survey was conducted within a popular reef community chat room, Reef Central (Dowling, 2004). Out of thirteen voluntary respondents, twelve were willing to pay more for tank raised or captive bred species. The reasons listed include reef ecosystem protection and better adaptation of the newly purchased fish to the tank environment. Twelve of thirteen respondents also did not believe that the current aquarium industry is sustainable.

Survey respondents were also asked what percentage of the organisms, including fish and corals, in their own tanks are captive bred (Figure 1). Of the survey respondents with fish, seven out of 11 did have at least one captive raised fish, and an average of 17 percent of all the fish in the surveyed tanks was bred in captivity. Cultivated fish currently account for just one to two percent of all marine fish traded (UNEP, 2003), so the average of cultivated fish found in this informal survey is well above the proportion found in the overall industry. However, several species, including clownfish, are currently showing promise for successful captive breeding.

The surveyed reef keepers were more likely to have captive raised invertebrate species in their tanks. On average, 60 percent of the coral reported in this survey was cultivated, and nine out of twelve respondents had over 50 percent captive raised colonies. The popularity of "frag swapping" has increased the variety of tank raised coral species available to the average hobbyist. Reef clubs around the country have been established, where members share care techniques and trade coral fragments, which can be used to establish a new coral colony in another tank. Frags are also available online, and research is being conducted in coral farming techniques (GARF, 2004; Dr. Mac Corals, 2004; frags.org, 2004, Ellis, 1999).

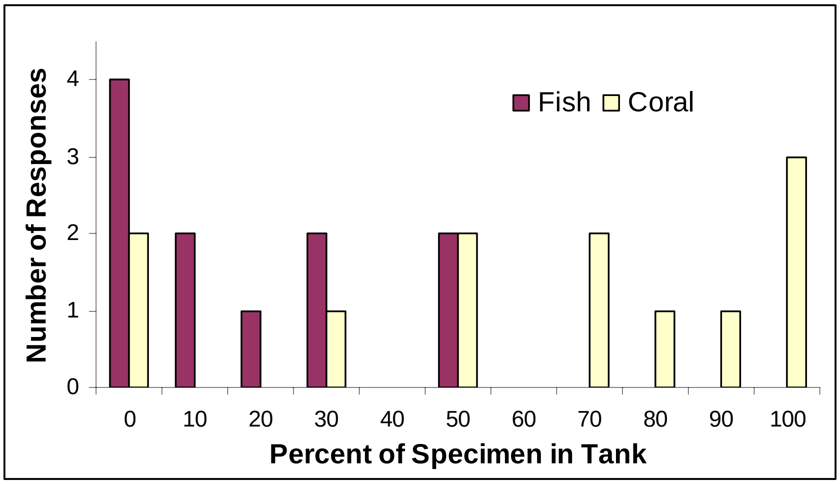

Figure 1: Informal Survey Responses Regarding the Number of Captive Bred Fish and Corals in Thirteen Reef Tanks

Another component of a reef aquarium that has benefited from farming is live rock. Rock-scaping is a popular aesthetic modification to individualize tanks. Rocks provide hiding places for fish, homes for invertebrates, and places for coral colonies to grow. In addition, if the rock is "live rock", beneficial bacteria that break-down fish waste products can thrive within a tank. In this way, hobbyists can create a self-sustaining ecosystem, which does not require as much chemical modification. Unfortunately, as mentioned in Section 5.0, excessive live rock harvesting can lead to habitat destruction and ecosystem decline. In response to growing concerns over destruction of reef habitat, the collection of live rock was prohibited in Florida in 1997. Several companies are instead providing aquacultured live rock, which is regular rock collected on land, placed for some time in the ocean, and later harvested and sent to customers full of beneficial bacteria populations and a variety of oceanic flora and fauna (UNEP, 2003).

A final captive breeding success story is that of the rose bubble-tipped anemone. Several years ago, the cost of this anemone species was over $300 per specimen. It was discovered that the anemone could be easily propagated within a tank, and once propagation became successful, the popularity of this species went up while the price went down drastically (Calfo, 2004).

Successful aquaculture, such as for clownfish, coral fragments, live rock, and the rose anemone indicate that there is a potential for captive breeding programs to become more prevalent in the future. This shift may have economic impacts on the aquarium trade industry. For example, if captive breeding programs were executed within the developed countries, an important revenue source may be removed from current specimen collectors. An alternative solution would be to encourage captive breeding industries to be developed within the current exporting countries. However, the supply-chain issues previously discussed may still prove to be a barrier to collectors, and potentially cultivators, in making a reasonable living (UNEP, 2004).

7.0 CONCLUSION

It is possible to enjoy a piece of the ocean in a saltwater aquarium in a sustainable and socially responsible fashion. However, the level of protection afforded to coral reefs will ultimately be a function of the level of consumer pressure placed on retailers. Too often, uninformed consumers purchase species that they do not know how to care for, or that are not appropriate to maintain in a tank environment. Sadly, as long as these species continue to be purchased (and soon after die), they will continue to be harvested and sold. MAC certification provides one avenue for an informed consumer to choose products that were harvested in an environmentally conscious manner. In addition, although captive breeding programs only supply a small fraction of marine specimen, the success, feasibility, and popularity of these programs are increasing and present a viable alternative to a customer wishing to purchase a hardier and more sustainable tank-raised species. Economic and environmental externalities, including issues related to supply chain, property rights, and properly accounting for environmental damage due to harvesting, should be dealt with using the principle of targeting, such that resource conservation can be achieved in the most efficient manner possible. By doing so, it should be possible to conserve the ocean's reefs so that they can be enjoyed by future generations.

8.0 REFERENCES

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