

## Finding Nemo's Reality: An Exploration of the Global Ornamental Fish Trade



The pink, bulbous fish in the picture above is of a Parrot Cichlid - a hybrid of the Midas Cichlid and the Red-head Cichlid. This fish is just a small part of the huge market that is the global fish trade. Over 1 billion fish are sold to individuals per year, which can rake in between \$200 and \$300 million net sales in that time (Marranzino, 2018). The United States in particular is the largest single-country importer of ornamental fish in the world. While the perspective of the aquarium fish world may look secluded to goldfish and clownfish, the trade has over 2,000 different species being bought, sold, and kept (Livengood & Chapman, 2020). Due to its popularity, international trade is essential for the market to exist. Ornamental fish are essential parts of the economies of many countries and nations, but what are the implications of the trade on a global scale, and how can policy be used to address shortcomings in the market?

South America, Asia, and Africa are the hotspots for freshwater fish, while Hawai'i, Fiji, and Oceania countries are the main exporters of saltwater (specifically reef-dwelling) fish. For

the invertebrates (like shrimp or lobsters), Florida is the largest supplier in the world (Lee, 2014). Within the two separate types of fish, there are two other specific differences that aquarium fish have: where they come from. Wild-caught fish are fish that are taken directly from their natural habitats and shipped to fish stores or private buyers. Captive-bred fish are bred by people in either fish farms or private sellers.

To examine how the economics and environmental worlds intersect with the ornamental fish trade, we must understand how the market works. Exportations are one of the core pillars of trade. The largest exporters of marine fish are represented by Figure 1, a density equalization map created by Townsend (2011). In this map, each country's export representation in the market is represented by how large they are obscured to be. We see large pieces of South America, Africa, and Asia as the largest features of the map. The disfigured appearance shows how important smaller countries are to the global market for ornamental fish.

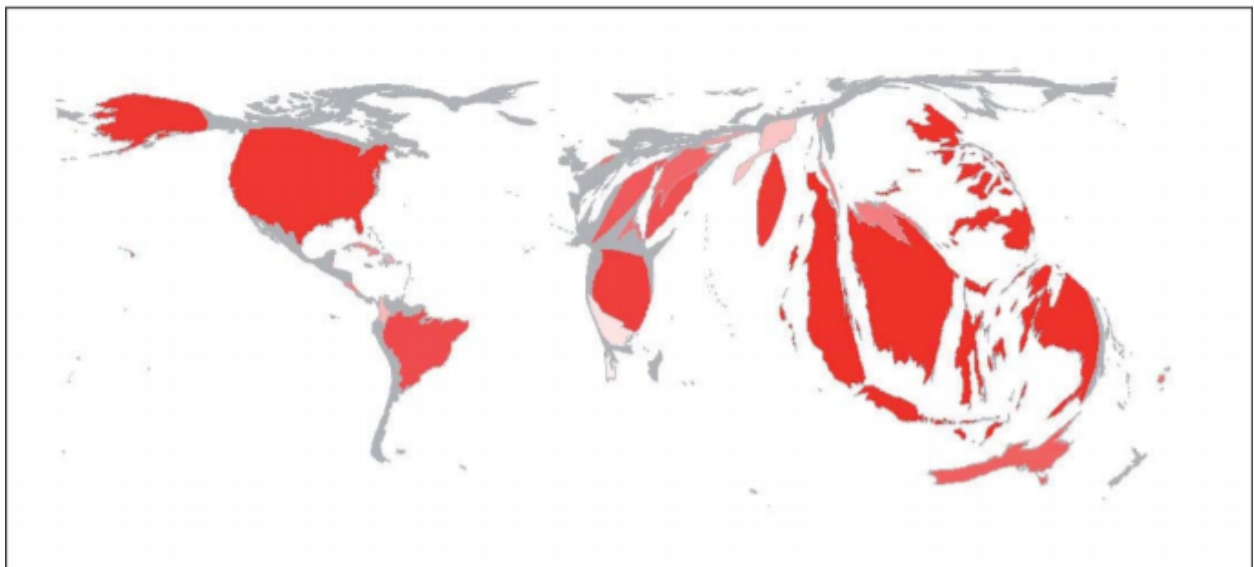


Figure 1: Density equalization of marine aquarium fish exporters. Source: Townsend 2011

One of the countries that exports aquarium fish is India. India's rich coral reefs around various islands, along with lagoons and rivers, allow many different species to thrive, which

means more aquatic animals to sell. About 150 species of fish are in the Indian ornamental fish market, with a majority of them being from freshwater. As of 2014, India only accounts for 1% of the total share of trade but is considered a “sleeping giant” for the large number of potential resources that have been unused (Rani, Immanuel & Kumar, 2014). The largest industry in India is currently agriculture, although it has seen a slight decline in the last decade (Plecher, 2020). Despite the small decline in participation in the agricultural sector, job-seeking individuals in the labor market have a decision to make. With the current status of India’s fish exports coming largely from wild-caught species, the promise of consistent income is not as certain as other industries, like agriculture or services. Location is important, as Indian workers on the coast or near a river are more likely to participate in the aquarium trade, as they have easier access to the water where the fish could be found. With 90% of the fish leaving India coming from Kolkata, individuals who live nearby have the comparative advantage of access to the fish trade compared to an 8% contribution in Mumbai (Rani, Immanuel & Kumar, 2014).

India’s export competitiveness (Export Competitiveness Index -XCI) was measured from the years 1991-2009 to see how impactful they are on the market over time. While the data shows some significant fluctuation, most years have an XCI of 1, meaning a positive growth for their fish trade, as seen in Figure 2. This increase in competitiveness means that India is becoming a stronger producer for ornamental fish in the international market, which is good for their economy as a whole (Rani, Immanuel & Kumar, 2014).

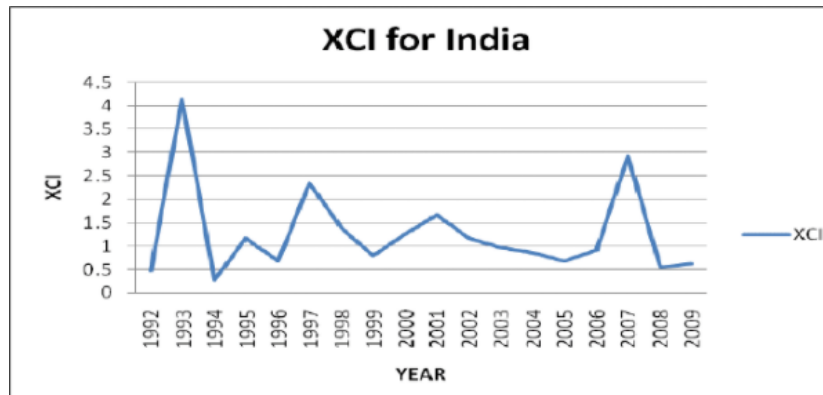


Figure 2: XCI for India from the years 1991-2009. Source: Rani, Immanuel & Kumar 2014.

However, this does still pose the question of the increasing environmental concerns that other countries are already experiencing. One of the issues that India has experienced with exporting pet fish has been possibly attributed to the inconsistencies in using wild-caught fish as their main source of exports (Rani, Immanuel & Kumar, 2014). Not only are wild-caught fish not a guaranteed good, removing the animals from their habitats can cause a chain reaction of environmental and economic impacts.

Wild-caught fish are not the only part of the producer side of the equation. Hybrid and tank-raised fish are a large part of the trade. While the ability to breed fish varies for freshwater and marine species, 90% of freshwater stock can be bred in captivity. Only 10% of the saltwater species that are kept in fish tanks have been successfully reproduced in an aquarium setting (Marranzino, 2018). Of these fish, only 6% of those captive marine animals are available commercially.

One of the most successful captive-bred fish species has been the clownfish. Since being bred in captivity, there have been dozens of species and colorizations that have been bred into the fish (Bale, 2017). As previously discussed, there can be severe environmental repercussions of removing wild fish from their natural homes. The aquarium industry, both hobbyists and retailers alike, are concerned with the depletion of the natural habitats that their beloved fish live in, so

advances in husbandry has allowed more successful captive breeding. Increased species participation in tank-raised breeding projects will offer additional substitution and supplementation in the market, which can reduce the uncertainty of taking part in the market as a producer or employee. Part of the motivation for these advances are to remove pressure from highly sought after fish, like clownfish in the post-*Finding Nemo* world. Since its sequel's release, the pressure has been reassigned to the blue tang, a fish whose captive breeding capabilities are currently low. Through research, another species of tang was successfully bred in captivity, so there is hope for continued improvements in the breeding of similar species of pelagic (open water) spawning fish (Bale, 2017).

Another major component of the trade is the countries that import the fish, both to retail and direct to consumers. The United States is one of the top importers of tropical fish globally. Between 2004 and 2005, over 8,000 invoices listed marine (meaning saltwater) aquarium fish as their contents. These invoices totaled 11 million fish entering the US in a single year (Rhyne et. al, 2012). As seen in Figure 3, North America dominates the importation end of the trade, followed by the European Union and Japan (Townsend, 2011). Figure 3 again represents each country as larger and darker in color to show where the most aquarium fish are imported to. With the exception of North America, the map shows the opposite of the previous density model (Figure 1), meaning that international trade is at the core of the ornamental fish market. Countries with higher GDPs seem to dominate the import end, which could be attributed to having additional money to spend on nonessential expenses like fish care. Consumerism could also be a driving force behind these specific countries dominating the imports.



Figure 3: Density equalisation of marine aquarium fish importers. Source: Townsend 2011

India is unique with the locations they export to, as there is no consistent leader in Indian ornamental fish imports. Singapore, Japan, Malaysia, United Arab Emirates, and the United States are the top five importers of Indian-exported ornamental fish (Rani, Immanuel & Kumar, 2014). The destinations of these fish are also important to the trade, as removing fish from the wild isn't the only environmental concern for the aquarium fish market. There is a possibility that consumers can buy a fish, no longer want it, and then release the foreign fish into local bodies of water, creating invasive species. One-third of the most invasive species in the world have been introduced to new locations because of the aquarium trade (Oskin, 2013). In one study in Europe, the common goldfish won the medal for the most impact for an invasive fish species (van der Veer & Nentwig, 2014).

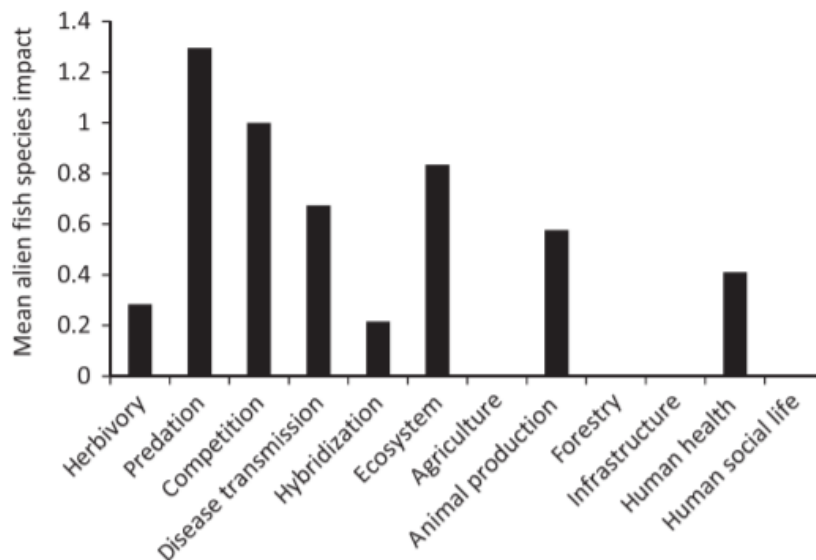


Figure 4: Distribution of the impacts of invasive fish in Europe . Source: van der Veer & Nentwig 2014

Most of the impact on native species was attributed to predation as the leading factor with competition for food being the second-most reason for the negative effect, followed by ecosystem alteration and disease, as seen in Figure 4. Interestingly, the study found no link to a negative economic outcome for the invasive fish. Monitoring where these fish originate from might help to reduce the impact of invasive species by understanding where there are large amounts of foreign species in the aquarium trade, as well as prevent future invasions.

Tracking the fish coming into the United States is no easy task. Currently, there is very little regulation of which fish are entering the country and almost all of the rules have to do with contagious diseases like Spring Viremia of carp (SVC) and Tilapia Lake Virus (TiLV) (Import, 2020). Most of the individual species are not tracked unless they are considered endangered, and not many marine aquarium animals are included in this list. One study found that a majority of fish coming into the US are all registered under the single category marine tropical fish (MATF). This means that many fish are not properly tracked on their way in, making it difficult to

understand how to help the industry, and thus suggesting that better data collection could be key in identifying which policies could have the most impact (Lee, 2014). Another concern with the import side of the trade is how fish are defined on invoices. Most fish and aquatic life in the trade have scientific identification names, however this does not mean that all fish are listed under this alias. Common names for fish are sometimes included instead of their official genus, leading to more confusion and murkiness in what is actually making its way into the States.

Environmental, economic, and policy intertwine to create the concerns and solutions for the global ornamental fish trade. The environmental impacts of wild fish being taken from their habitats and then exported internationally can be large. Some places, like Hawai'i, Australia, and Fiji manage and monitor the aquarium trade activities well, but not all countries are capable of the same level of management. The Philippines and Indonesia account for 86% of the total imported fish to the United States but do not monitor their exports as closely.

Some fishing companies use cyanide to make the fish easier to catch, which can be bad for both the fish and their natural habitat (Lee, 2014). This creates a variety of issues, as 75% of fish will die within an hour, and of the surviving fish, 30% will then perish as well (Marranzino, 2018). Not only are fish and invertebrates being sought out for their beauty, but coral directly from reefs are also used in the aquarium industry. Corals are impacted in several ways through this, too. Urchins and other herbivores are critical to the health of the reef, as some act as defenses of overgrowth algae that could choke and kill coral. Reef fish also play important roles in their ecosystem and removing any, a mixture, or all of these components can be detrimental to the health of the reef (Ryhne et. al, 2012). The coral reefs are already struggling due to pollution and destruction of their habitats caused by human industry, so identifying ways for the aquarium



trade to not only stop their harm, but negate the harm of other industries is incredibly valuable (Rhyne, et. al, 2014).

Ornamental fish, particularly marine animals, provide a lot of economic opportunity for many communities, especially those who are based in coastal areas or populated lagoons. Well-maintained fisheries lead to healthy fish, healthy fish lead to increased sales, and increased sales incentivize the protection of natural habitats (Bale, 2017). For some of these regions, the fish trade is one of the few opportunities for revenue and employment (Teletchea, 2015). With the industry generating \$200-\$300 million annually, there's no question as to why it is such a popular and important market. There is little information available about how many people are employed by the aquarium industry, but understanding how many individuals are impacted by the trade might help to incentivize the policy changes outlined later.

Policy change can be the key in discovering the balance between environmental sustainability and economic prosperity. In order to make any sort of policy suggestion, reviewing the current relevant legislation can help inform what is and is not working. One of the issues with regulation is simply how many species there are in the aquatic world. There are thousands of different species of fish, coral, and invertebrates that are part of the trade, leading to difficulty managing what each species needs in terms of policy (Marranzino, 2018). Strained international relationships can cause rifts in the aquarium trade, too. There are a few species of marine animals that live in the Red Sea that cost more than other similar species. The reason for this price difference is the contentious nature of the countries surrounding the Red Sea (Gosnell, 2009). If the fish are more dangerous or tedious to collect, this will result in a shortage of specific fish in the market. A shortage then leads to higher prices, which can increase the value of the fish to a collector, or turn away potential buyers because of the high cost.

Cyanide poisoning is a popular, but illegal, way to catch fish. In the Philippines, despite legislation against its use, there are not enough people to patrol the waters to ensure that people are fishing in an ethical and legal way (Lee, 2014). This points to a larger issue with funding and prioritization of labor supply. Exportation is not the only part of the policy realm that needs to see change. “After working with stakeholders over a specified time period, the U.S. should prohibit the import or export of any coral reef species unless accompanied by certification that the products were not taken through the use of destructive fishing practices” (Lieberman, 2001). Legislation similar to what Lieberman is suggesting would encourage more ethical practices with catching marine species, which would not only benefit the natural habitat of the coral reefs, but increase prices for the healthier fish.

There are several areas of further research that have limited the complete understanding of the aquarium industry. First, globally there is a lack of information and statistics about species numbers, individuals involved with or employed by the production or exportation of aquatic life, and regulation with what can or cannot enter different countries. The missing information on employment information can mean that countries don’t know how critical the trade is to their citizens, which could be part of the reason why there is the lack of regulation generally. Increased data collection and consistency can help clarify and alleviate the concerns of this paper.

Considering the research and limitations, there are several policy suggestions that would benefit both the environment and the economy. First, creating an internationally recognized system or organization to import and export fish which would include a specific way to identify the fish or aquatic species they are sending or receiving. Having international exchanges at the core of the market means that there is likely a need for a global monitoring system (Biono &

Burki, 2020). This would reduce the amount of confusion in the trade with which species need to be watched more carefully for conservation purposes, as well as allow retailers to be more confident in what they are selling. Biono and Burki recommend being specific in tracking the “number of traded specimens; diversity of species; country of origin; and source, i.e., whether specimens are wild-caught, captive-bred, or captive-reared.” Additionally, encouraging data collection can help inform future policy decisions surrounding the environment and the economy.

The next recommendation would be to subsidize the materials for proper fisheries, as well as the education to run them for communities who rely on wild-caught fish for income. Well maintained fisheries are much better for the environment and reef recovery, but they do admittedly come with a higher price than pulling fish directly from the ocean or river. This plan would require government or international funding to come together, but many aquarists have committed to conservation as part of their love of fish, and many efforts have already been made to preserve the coral reefs already.

Finally, importing countries should adopt legislation that will only allow fish or aquatic species to enter their country under the infallible knowledge that the animals were ethically caught or raised. While Lieberman specifically notes their policy suggestion for marine life, applying the concept of import responsibility to all aquatic species is invaluable. This is another situation where increasing the amount of available information is invaluable, as monitoring the origins of each animal will be much easier with a specific and global norm. Holding the importing countries accountable monetarily would decentivize the generic importation systems that are currently in place to avoid being fined or otherwise punished by the hypothetical overarching ornamental fish organization.

Ornamental fish are a beautiful addition to people's homes, a way to teach conservation, and a livelihood for thousands of people across the world. In order to continue to enjoy their beauty both in private homes and in the wild, addressing concerns with statistical data and organization, sustainable fisheries, and ethically-harvested fish are essential to furthering their preservation.

## Works Cited

Bale, R. (2017, August 2). *Breeding Aquarium Fish Can Help Save Reefs*. National Geographic.  
<https://www.nationalgeographic.com/news/2016/05/160503-marine-aquarium-trade-captive-bred-wild-caught-fish/>.

Biono, M. V., & Burki, R. P. (2020). A Systematic Review of the Ornamental Fish Trade with Emphasis on Coral Reef Fishes—An Impossible Task. *MDPI*.

Gosnell, J. J. (2009, September). *How Fish Get from Ocean to Tank: Tropical Fish Hobbyist Magazine*. Home | TFH Magazine.  
<https://www.tfhmagazine.com/articles/saltwater/from-reef-to-retail>.

Import: Bring Live Animals Into the United States. (2020, December 11). Retrieved December 17, 2020, from  
<https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-and-animal-product-import-information/imports/live-animal-imports>

Lee, J. J. (2014, July 18). *Do You Know Where Your Aquarium Fish Come From?* National Geographic.  
<https://www.nationalgeographic.com/news/2014/7/140718-aquarium-fish-source-sustainability-animals-ocean-science/>.

Lieberman S. and Field J. 2001. Global solutions to global trade impacts? p. 19–24. In: Best B. and Bornbusch A. (eds). Global trade and consumer choices: Coral reefs in crisis. Papers presented at a symposium held at the 2001 annual meeting of the American Association for the

Advancement of Science. Washington D.C. USA: American Association for the Advancement of Science.

Livengood, E. J., & Chapman, F. A. (2020, April 29). *The Ornamental Fish Trade: An Introduction with Perspectives for Responsible Aquarium Fish Ownership*.  
<https://edis.ifas.ufl.edu/fa124>.

Marranzino, A. (2018, July 16). *Where do aquarium fish come from?* Massive Science.  
<https://massivesci.com/articles/aquarium-fish-source/>.

Oskin, B. (2013, January 14). *Protect the Oceans: Don't Flush That Fish!*  
<https://www.livescience.com/26238-invasive-species-from-aquariums.html>.

Plecher, P. (2020, October 20). India - Distribution of the workforce across economic sectors 2020. Retrieved December 17, 2020, from  
<https://www.statista.com/statistics/271320/distribution-of-the-workforce-across-economic-sectors-in-india/>

Rani, P., Immanuel S., Kumar, N. R. (2014). Ornamental Fish Exports from India: Performance, Competitiveness and Determinants. *International Journal of Fisheries and Aquatic Studies*.

Rhyne, A. L., Tlusty, M. F., & Kaufman, L. (2014, January 15). *Is sustainable exploitation of coral reefs possible? A view from the standpoint of the marine aquarium trade*. Current Opinion in Environmental Sustainability.  
<https://www.sciencedirect.com/science/article/pii/S1877343513001942>.

Rhyne, A. L., Tlusty, M. F., Schofield, P. J., Kaufman, L., Morris, J. A., & Bruckner, A. W. (2012). Revealing the Appetite of the Marine Aquarium Fish Trade: The Volume and Biodiversity of Fish Imported into the United States. *PLoS ONE*, 7(5).

Teletchea, F. (2015, April 14). *Domestication level of the most popular aquarium fish species: is the aquarium trade dependent on wild populations?* ResearchGate.  
[https://www.researchgate.net/profile/Fabrice\\_Teletchea/publication/306358995\\_Domestication\\_level\\_of\\_the\\_most\\_popular\\_aquarium\\_fish\\_species\\_is\\_the\\_aquarium\\_trade\\_dependent\\_on\\_wild\\_populations/links/57bac08008aedfe0ec971e4e.pdf](https://www.researchgate.net/profile/Fabrice_Teletchea/publication/306358995_Domestication_level_of_the_most_popular_aquarium_fish_species_is_the_aquarium_trade_dependent_on_wild_populations/links/57bac08008aedfe0ec971e4e.pdf).

Townsend, D. (2011, December). Sustainability, equity and welfare: A review of the tropical marine ornamental fish trade. SPC Live Reef Fish.

Van der Veer, G., & Nentwig, W. (2014). Environmental and economic impact assessment of alien and invasive fish species in Europe using the generic impact scoring system. *Ecology of Freshwater Fish*. doi:10.1111/eff.12181