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Effects of Salinity on Reproduction and Survival of the Calanoid Copepod *Pseudodiaptomus Pelagicus*

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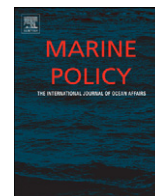
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Short Communication

How U.S. ocean policy and market power can reform the coral reef wildlife trade

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ABSTRACT

As the world's largest importer of marine ornamental species for the aquaria, curio, home décor, and jewelry industries, the United States has an opportunity to leverage its considerable market power to promote more sustainable trade and reduce the effects of ornamental trade stress on coral reefs worldwide. Evidence indicates that collection of some coral reef animals for these trades has caused virtual elimination of local populations, major changes in age structure, and promotion of collection practices that destroy reef habitats. Management and enforcement of collection activities in major source countries such as Indonesia and the Philippines remain weak. Strengthening US trade laws and enforcement capabilities combined with increasing consumer and industry demand for responsible conservation can create strong incentives for improving management in source countries. This is particularly important in light of the March 2010 failure of the parties to the Convention on International Trade in Endangered Species (CITES) to take action on key groups of corals.

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1. Introduction

The United States is the world's largest importer of marine ornamental species for the aquarium, curio, home décor, and jewelry industries, importing more than 50–60% of live coral, coral reef fish and invertebrates in trade [1,2] (Fig. 1). These widespread and growing trades add to the cumulative stresses that coral reefs are facing from climate change, ocean acidification, overfishing, destructive fishing and land based pollution. Unfortunately, the recent meeting of the Convention

on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in March 2010 once again failed to take action to regulate trade in red and pink precious corals threatened by trade activities. This rejection by the CITES member governments highlights the urgent need for other action. As the world's largest consumer of marine ornamental species, the U.S. has an opportunity to leverage its considerable market power to promote more sustainable trade and reduce the effects of ornamental trade stress on coral reefs worldwide.

More than 40 scientists, government officials, industry leaders, and representatives from conservation and animal protection organizations met in May 2009 in Washington DC to explore the current state of knowledge of the trade in coral and coral reef species for ornamental purposes, and discuss actions that could be

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taken in the U.S. to promote a more responsible, sustainable and humane trade. Strengthening U.S. laws and enforcement capabilities combined with increasing consumer and industry demand for more responsible practices can create incentives for improved management in source countries and reduce the ecological impacts of U.S. consumption in traded species.

2. Volume of trade

Existing data indicate that the diversity and volume of species traded is substantial and growing. Trade in coral and coral reef species originates from at least 45 countries, and removes up to 30 million fish, 1.5 million live stony corals, over 2 million kilograms of dead coral, 30–50 metric tons of red and black coral and over 2500 metric tons of shells per year from coral reefs [1,3–6]. The global trade in marine ornamentals for aquaria alone targets over 1500 species of reef fishes, 500 species of invertebrates, hundreds of coral species, as well as live rock [7]. Between

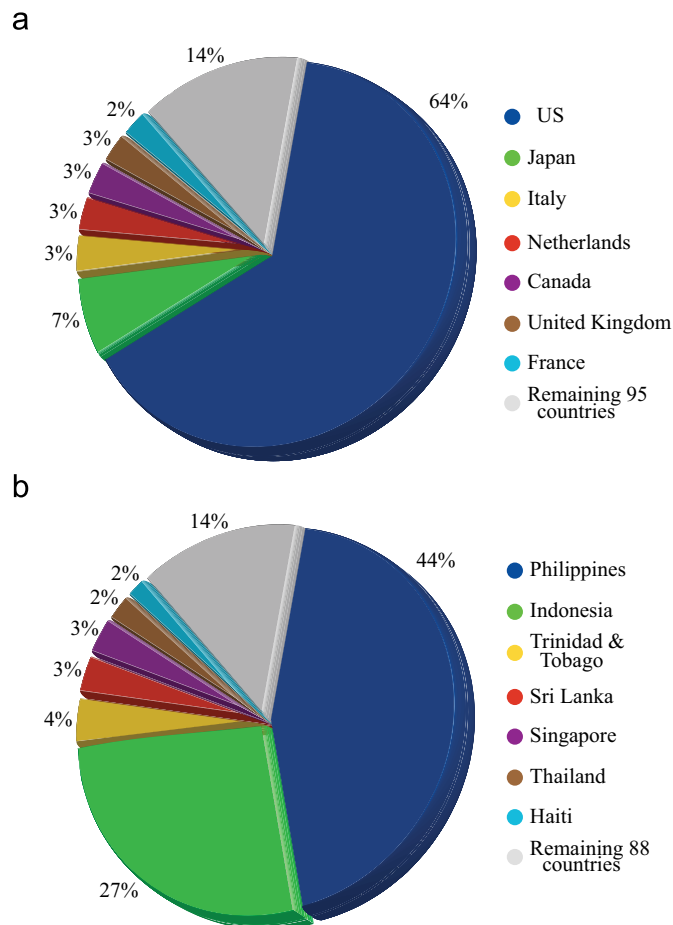


Fig. 1. (a) Coral imports worldwide, by importing country. Data obtained from the UNEP-WCMC CITES Trade Database [8] for trade in CITES-listed species of coral 2004–2008 demonstrates that the U.S. imports 64% of the total coral species in numbers of specimens. The vast majority originated in the Coral Triangle region, with Indonesia having exported over 60% of the corals. This chart does not include coral jewelry and other worked coral products, which have different units of measurement in the database. Nonetheless, the data show that the U.S. is also the leading importer of these products. (b) U.S. imports of marine tropical fish, by exporting country. Data obtained from the U.S. Fish and Wildlife Service for the U.S. importation of live marine tropical fish (2004–2008) show that 71% of the trade originated in just two countries in the Coral Triangle, the Philippines and Indonesia. It is worth noting that these data were taken at face value and are dependent on the accuracy of the reported type and volume of items in trade.

1988 and 2007, the imports of live corals taken directly from reefs to the U.S. has increased 600%, while the global volume of live coral imports increased nearly 1500% [8].

3. Ecological impacts

Trade in some species has caused the virtual elimination of local populations, major changes in age structure, and promotion of collection practices that destroy reef habitats [9–12]. For example, populations of the Banggai cardinalfish (*Pterapogon kaudneri*), an endemic species from a remote archipelago in Sulawesi, Indonesia, have been substantially reduced or eliminated throughout much of the species' range since its popularity for marine aquaria soared in the late 1990s [13]. Long recognized as the "shell capital of the world," the Philippines have experienced boom and bust cycles from overfishing and many once abundant mollusks have become commercially extinct due to overharvesting for the curio trades [3]. Precious and semi-precious corals (i.e. black and red corals) used for jewelry and home decorations have been overfished as collectors deplete certain areas and animals, then move on to other geographic areas, deeper waters, and other species [14].

Species taken for the live aquarium trade are extremely perishable, increasing the potential for overexploitation as collectors gather additional live animals from the reef to compensate for the high mortality that can occur during holding and transport [15]. The live aquarium trade is also a pathway for invasive and non-native species into the U.S. that can cause significant impacts to local and regional biodiversity [16,17]. For example, introduction of the Indo-Pacific Lionfish (*Pterois volitans*) into U.S. Atlantic waters was very likely from an aquarium [18], and they have spread rapidly northward along the eastern seaboard of the U.S. and southward throughout the Caribbean causing severe impacts to local fish populations [19].

4. Management and regulation

Management and regulation of species collected for the marine ornamental trades are not sufficiently developed in most countries. Weak local and national governance capacity in major source countries, such as in Indonesia and the Philippines, combined with high international demand have resulted in limited and ineffective management. 'Roving collectors' that move throughout the region and within countries in search of higher value species collect a substantial portion of marine aquarium fish and can undermine local management efforts [20,21]. Inadequate enforcement of the few existing laws allows collectors to utilize illegal and destructive collection methods, such as sodium cyanide to collect fish, that have negative impacts for the health of non-target species and collectors [22,23].

5. Recommended action

With continuing high demand from the United States, many source countries have few incentives to improve management practices or strengthen trade policies. Strengthening U.S. laws and enforcement capabilities combined with increasing consumer and industry demand for more responsible products can create strong incentives for improving resource management in source countries. Workshop participants identified four key areas in which U.S. actions could influence trade practices.

5.1. Reform U.S. laws and regulations on the trade

Currently, US legal and regulatory tools governing the import of coral and coral reef species are limited. The primary tools to regulate trade into the U.S. include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Endangered Species Act (which implements CITES in the U.S.), and the Lacey Act. Although CITES requires that international trade of species included in Appendix II is regulated so that collection is not detrimental to species survival or its role in the ecosystem, only a few groups of the thousands of coral reef species in the marine ornamental trades are currently listed. In the meantime, many thousands of other species traded will remain unexamined and unlisted, exacerbated by limited management in source countries. In 2007, and again in March 2010, efforts to list red and pink corals under Appendix II of CITES failed, despite clear evidence of the need for increased protection, highlighting the limitations of relying solely on CITES as a policy tool. The Lacey Act prohibits wildlife imports that were obtained in violation of foreign laws. While the import of animals taken with illegal collection practices such as cyanide is clearly a violation, the U.S. lacks internationally recognized cyanide detection tests to collect evidence needed for enforcement [22]. The Lacey Act also allows the U.S. to list and ban injurious species and provides for the humane and healthful transport of live animals into the United States. However, explicitly listing species as injurious is a cumbersome and time-consuming process. Without listing, the Act cannot be applied. Moreover, there are currently no mandatory or enforced regulations in place for humane and healthful transport of fish and invertebrates.

Additional tools are needed to address these legal and regulatory gaps and ensure that the U.S. is not importing coral reef species (or their products) collected through poorly managed, unsustainable, or destructive practices. The current challenge will be constructing a new trade policy for coral reef species that addresses both negative impacts to the reef resources and promotes the development of sustainable and humane alternative products to supply a growing global demand.

5.2. Improve enforcement

The U.S. Fish and Wildlife Service is tasked with inspecting shipments of wildlife imported into the country to ensure that they comply with the law. The overwhelming number of shipments and animals, as well as the challenges of properly identifying taxa, make enforcement difficult [24]. Additional resources, training, and better tracking systems are needed to improve trade data and adequately address the problem. Mortality of live animals in trade could also be reduced by improving and enforcing the voluntary Live Animal Transport Regulations of the International Air Transport Association used for humane transport of live animals.

5.3. Shift market demand to sustainable products

Changing U.S. market demand for poorly managed coral reef species to those acquired by more sustainable practices can shift market incentives. Over the last decade, there have been voluntary efforts to improve practices in the marine aquarium trade, including efforts to better track trade, improve standards of care, develop breeding and mariculture initiatives, and propagate corals for trade.

Although there have been major efforts towards voluntary certification of the live animal trade for aquarium fish, truly shifting U.S. market demand will require substantial consumer

education, engagement and proactive leadership by responsible businesses, combined with policy reform. Businesses can work with environmental nongovernmental organizations to facilitate access to more sustainable and humane sources and identify best practices to reduce mortality of collected animals. Licensing requirements for importers, wholesalers, and retailers could improve recordkeeping and husbandry practices and create a barrier to entry for the worst players where mortality is highest.

5.4. Promote reform and best practices in source countries

Ultimately, real change must occur in source countries. All countries in which coral and coral reef organisms are collected – including parts of the U.S. – should maintain high standards for conserving coral reef ecosystems in their practice of trade. Regional and U.S. investments in conservation efforts in the Coral Triangle region, a major source of the ornamental trade, could help address fundamental management problems. High demand in the U.S. for coral reef products creates perverse economic incentives that can undermine efforts to strengthen their management. Therefore, efforts to promote ecosystem-based management in source countries should be paired with U.S. action to influence trade for sustainable use of these resources.

6. Conclusion

In light of the continued failure of CITES, it is clear that other approaches are necessary to conserve vulnerable marine ornamental species. Collection of these animals can have significant negative impacts on already stressed ecosystems and undermine local management efforts. The U.S. should assume its role as an international leader in coral reef conservation and take steps to reform the international trade it drives.

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