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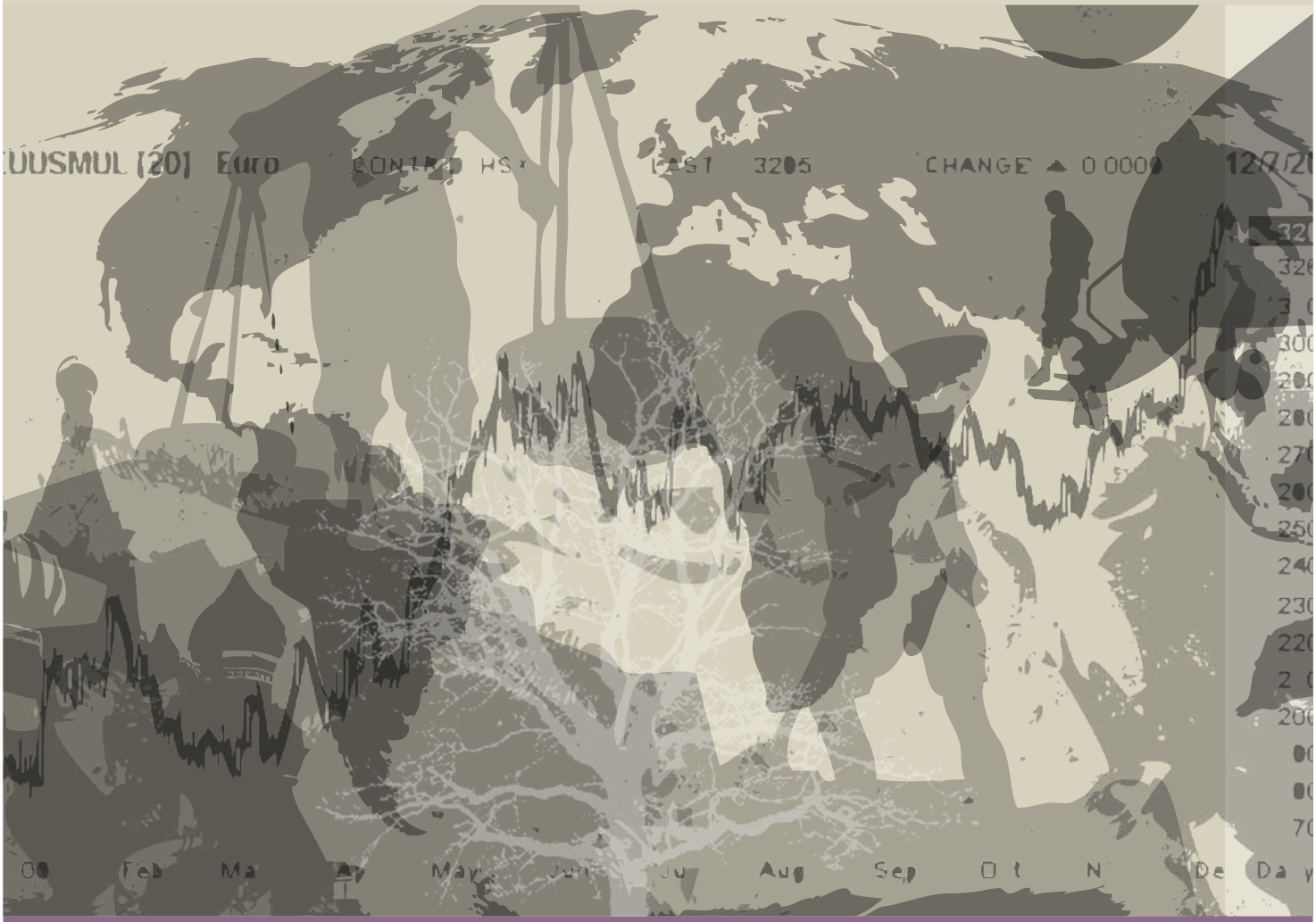

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Abstract
Despite estimates that the global butterfly trade generates over US$100 million annually in sales of pupae for exhibitions and deadstock for a range of collector and artisanal uses, almost no research has been conducted that unpacks the dynamics of these value chains. This paper remedies this gap by highlighting the governance structure of the value chain, with important implications on the benefits for chain participants, upgrading strategies, sectoral sustainability, and the potential for new market entrants. Our research on live butterfly chains reveals the fragility of current modes of economic organization that promote overproduction as threatening the long-term viability for the industry as a whole. We propose an alternative governance model based on the use of individually transferrable quotas, or ITQs, as a means of improving the performance of certain butterfly value chains.

KEYWORDS: Butterflies; butterfly farming; conservation; value chain; governance; ITQs

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Contents

Introduction

Butterflies are one of nature's most charismatic and recognized species. Their beauty is highlighted in a variety of contexts, ranging from established exhibitions in North America, and Europe, and Asia, mounted displays for collectors, their use in a variety of artisanal designs, and their ubiquity in advertising and marketing campaigns for a diversity of consumer products. A rather dated study by Parsons (1992), and reiterated in a recent review by Boppré and Vane-Wright (2012), estimated that the global market value of products generated by the butterfly sector exceeded US$100 million. However, virtually no research has attempted to systematically validate this figure, and the economics of the butterfly sector, for all of its diversity, remains thoroughly under-researched.

One of the important contributions of the commercialized butterfly sector, particularly the trade in live butterflies, is through its linking of conservation and livelihoods opportunities in the developing world. Monetizing or creating value from products associated with natural resources such as forests is one means of aligning incentives between different stakeholders to both take joint ownership of forest conservation and to realize the value of the forest in generating other forms of economic activity. Butterfly farming has played an important role in this manner. Over the past twenty-five years, a number of butterfly farms in tropical parts of Central and South America, East Africa, and Southeast Asia, have been established to supply exhibitions in North America and Europe with live pupae, which then hatch and emerge as butterflies for a period of up to several weeks. These butterfly farms necessarily maintain an important symbiosis with their natural environment, as the conservation of forest resources is critical as a supply of host plants to breed butterflies in captivity and to ensure genetic diversity of breeding stock. Studies by Gordon and Ayiemba (2003) and Morgan-Brown (2007) noted the positive benefits on the conservation of forest resources and perceptions about the environment among butterfly farmers due to butterfly farming in Kenya and Tanzania, respectively. From a livelihoods standpoint, butterfly farming can also help create new full-time and part-time employment opportunities and generate income-generating activities in remote areas where such opportunities are limited at best. Scurrah-Ehrhat and Blomley (2006) found that butterfly farming generated an additional 17 percent to the income of project participants in the Amani project in Tanzania, while Gordon and Ayiemba (2003) noted that the top earner from the Kipepeo butterfly project in Kenya was a disabled man that

could easily embrace butterfly farming as a livelihood activity more suitable for his condition.[1]

As noted above, the economics of the butterfly sector remained under-researched, particularly outside specific cases evaluating the establishment of butterfly farms. A particular gap is an analysis of the butterfly sector through the lens of its value chains, in terms of characterizing the actors and modes of economic organization that underpin economic activities and their linkages with conservation and the environment. The latter point is particularly salient as to whether (and how) butterfly farming can be "scaled up" and highlighted as a model of sustainable development or whether there are lessons for other, related activities that link conservation with livelihoods. Boppré and Vane-Wright (2012), in their recent review of the butterfly sector, focused primarily on distribution routes, but did not characterize the governance of the value chain either locally or globally. Procházková and Rich (2011) recently looked at different global butterfly value chains based on available secondary data, including a preliminary assessment of governance and distributional benefits from participation, though their analysis was incomplete based on limited published or grey literature.

This paper builds on earlier works by providing a comprehensive analysis of the local and global value chains for live butterflies. In-depth primary field interviews with farmers and other stakeholders in Europe, East Africa, Southeast Asia, and Central America allowed the authors to fill in the gaps from past analyses, especially from the standpoint of trade flows and modes of economic organization. Our analysis pays close attention to the governance structures, defined as the coordination and transactions mechanisms, implicit within the butterfly value chain (Kaplinsky 2000; Gereffi et al. 2005). In particular, we find that value chains for live butterflies are fragile and threatened by a combination of recent market shocks and poor governance. The industry is replete with significant oversupply of pupae and stagnant demand from exhibitions, which has been exacerbated by recent EU regulations that prohibit the transport of pupae without obtaining a costly veterinary certificate. This has resulted in a consolidation of buyers in Europe and squeezed out smaller suppliers that cannot ship in bulk to reduce the unit costs associated with the new inspection regulations. Moreover, the oversupply of pupae, particularly in Africa, manifests itself from governance structures that promote scaling out of production capacity rather than coordinating the output of producers directly with existing demand. The high inventory found among African producers, who often cannot sell much of their stock at various times of the year,

[1] Fieldwork in 2012 revealed that one of the top earners at Kipepeo is a disabled man with one leg, and elephantitis in the remaining leg, and who earned several hundred U.S. dollars per month.

discourages participation and weakens coordination, particularly in the face of adverse market shocks.

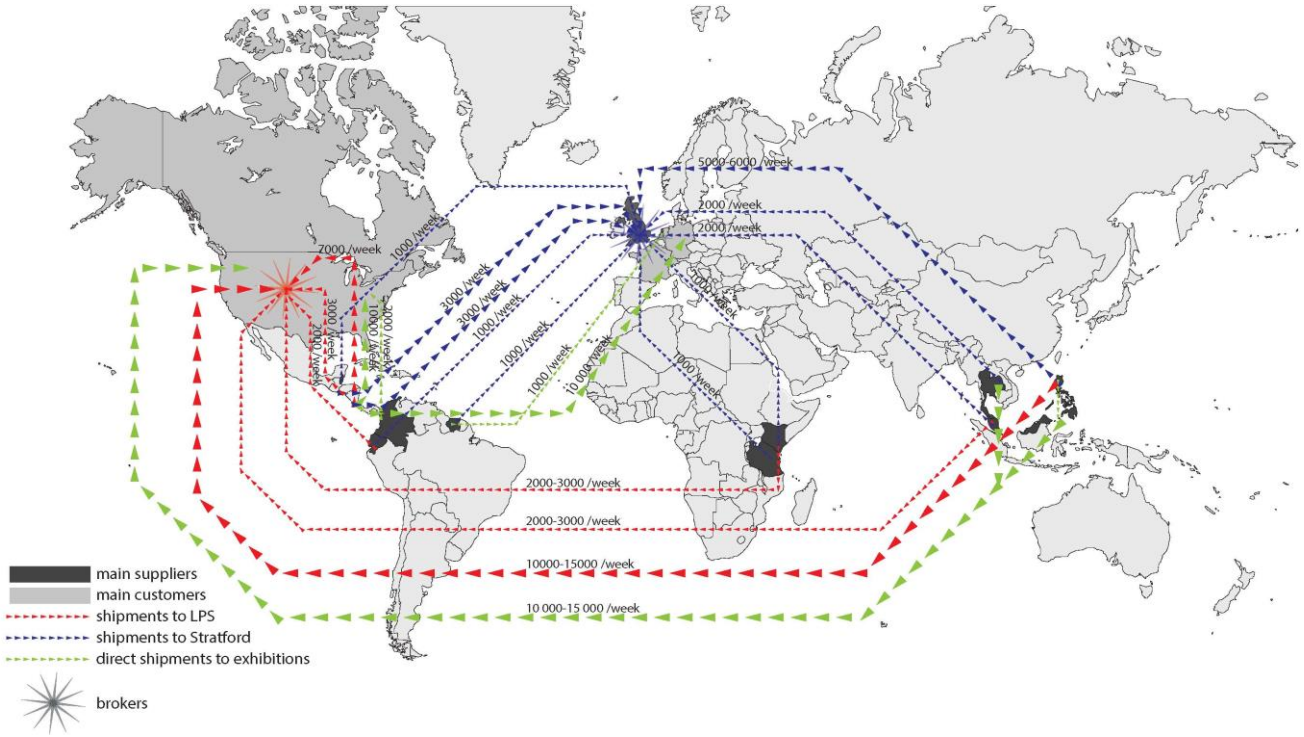
In the absence of tight, relational forms of governance or pure vertical coordination, we suggest a role for ITQs, first conceived as a means to manage fisheries stocks, as a means to overcome the governance failures existing within most butterfly value chains and to smooth inventories at the producer level.

An overview of the market for live butterflies

The market for live butterflies for exhibition originated in the United Kingdom in the 1970s on the island of Guernsey, spurred by the need to generate alternative revenue from infrastructure built for the tomato industry that had previously crashed (Procházková and Rich 2011). A boom/bust cycle followed in the United Kingdom during the 1980s, with the establishment of additional butterfly houses, some of which are attached to zoos, in Europe and North America over the past twenty to thirty years (Boppré and Vane-Wright 2012). Today, there are several thousand butterfly houses and gardens of various sizes throughout the world, with Boppré and Vane-Wright (2012) estimating some 40 million visitors to these per year.

The supply of live tropical butterflies to Europe and North America (the regions with the largest butterfly houses) comes from three main sources: Central and South America, East Africa, and Southeast Asia. Figure 1 illustrates the volumes of these flows in peak periods of the year based on informant interviews with producers in supplying regions and buyers in Europe and North America and (where possible) published trade volumes. Southeast Asia, mainly the Philippines and Malaysia, is the largest supplying region of pupae, accounting for between 50-70 percent of pupae for butterfly houses. The appeal of Southeast Asian butterflies is primarily price – pupae at wholesale in Europe typically retail for less than US$1 per pupae for common species; prices at the producer level are less than US$0.50. Central and South American exports are about 30-40 percent of pupae in butterfly exhibitions and include popular species such as the Blue Morpho. Pupae from Central and South America tend to retail at a premium over Asian butterflies, with F.O.B. export prices per pupae in the range of US$1.50-2.00. African butterflies, chiefly from Kenya and Tanzania, are no more than about 10 percent of the market and retail at prices similar (and sometimes higher) to Latin American species. Some butterfly farms and buyers have established long-standing supply links based on trust and reliability of supply. Seasonality is a key characteristic of the live butterfly trade. Many butterfly houses in Europe and North America are only open from March-November, with demand for pupae falling considerably during the winter months.

Figure 1. An overview of trade patterns in the live butterfly market



Source: Developed by the authors based on fieldwork and interviews, July 2012-February 2013.

An increasingly problematic trend for the industry is that prices for butterflies have remained static in nominal terms, while the costs of production, ranging from shipping costs, materials, and labor, have risen precipitously. Indeed, in some cases, the prices for pupa have fallen in nominal terms, despite a steady increase in the admission prices of the exhibitions that house imported butterflies. An important future need in the production side of the sector will be to improve technology, although this has potential equity concerns, as many smallholder producers are unable to afford such cost-saving technologies (personal communication, Feb. 2014).

An important development in the live butterfly trade concerns changes in shipping carriage to the European Union (EU). Before 2009, many butterfly suppliers would typically transport live pupae via DHL, FedEx, or other courier services that provided economical transport for small volumes of pupae (100-200 pupae). However, recent legislation has classified butterflies as "live animals," necessitating a veterinary certificate and veterinary check to get them into the EU, at a cost of approximately £160/shipment to the UK (personal communication, Oct. 2012). The effect of this has been to make smaller shipments from marginal suppliers in Asia and Africa (e.g., Sri Lanka, Madagascar,

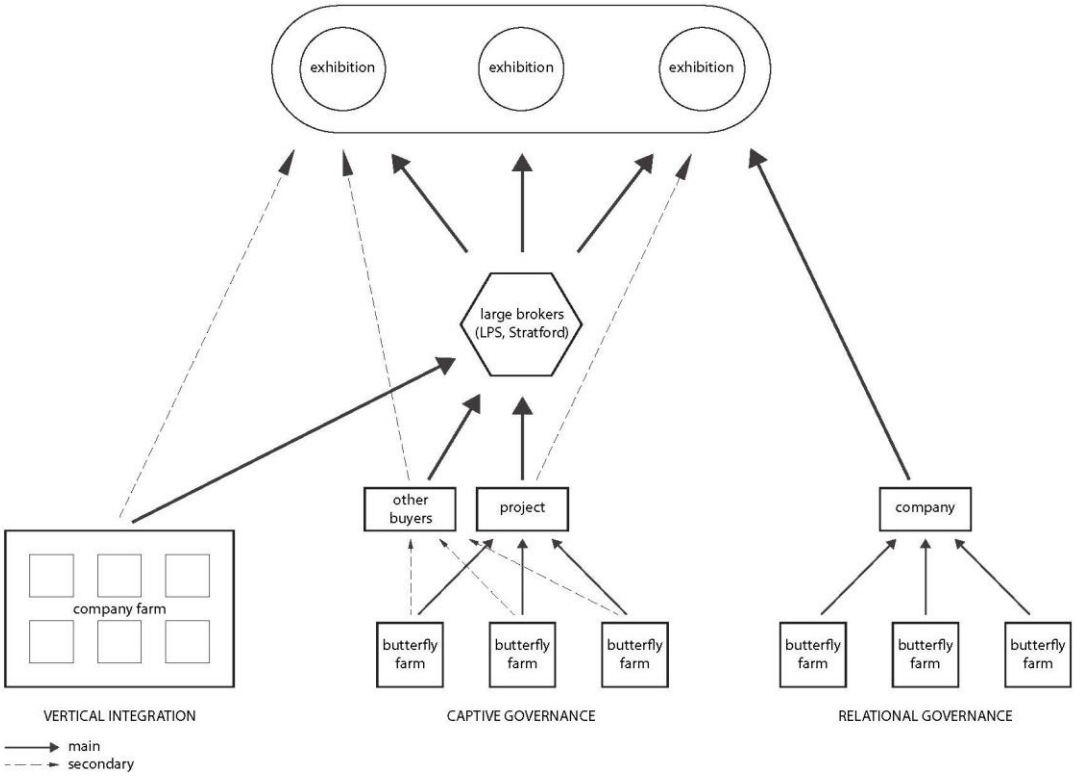
Uganda) not cost-effective. For larger suppliers in East Africa, transport costs to Europe have increased by a factor of four, necessitating the bundling of shipments from Kenya and Tanzania (personal communication, July 2012). With this change in shipment rules has come a significant consolidation of buyers within Europe – Stratford Butterfly Farm has taken market share from smaller buyers and now maintains a dominant share in brokering trade between tropical suppliers and buyers in European butterfly exhibitions.

Governance structures of live butterfly value chains

In this section, we focus more in depth on the value chains themselves for live butterflies, focusing in particular on governance structures. Governance in this context is defined as the key actors and mechanisms used that coordinate and lead activities and processes within the value chain (Kaplinsky 2000). Gerreffi et al. (2005) have developed different typologies of governance based on the complexity of transactions, codification of knowledge, and capabilities of actors within the value chain. These can range from diffuse, arms-length market based forms of governance, in which the main coordinating mechanism is price, to vertical integration, whereby a single firm owns and manages activities within the value chain itself. As value chain governance moves from the market-oriented to more hierarchal forms, there is necessarily a movement towards greater coordination on quality, volumes traded, and investments between value chain actors to facilitate transactions (Wever et al. 2012).

In order to motivate the governance structures present in the live butterfly trade, we first need to characterize the linkages and relationships present within the value chain through a mapping of different value chains for live butterflies. We expand the analysis found in Procházková and Rich (2011) by identifying three main types of value chains present in the live butterfly trade market. In all cases, downstream sales to foreign buyers are basically the same from each type of supply base and described subsequently. Figure 2 illustrates each of these chains graphically.

Figure 2. Value chains for live butterflies based on different governance mechanisms



Source: Developed by the authors based on fieldwork and interviews, July 2012-February 2013

The first type of governance structure observed in the live butterfly market is a vertical integration model. In these cases, production is either centralized in one relatively large farm or a number of farms that are directly owned by a central organization. Examples of this model include production in El Salvador, Ecuador, Malaysia, and the Philippines. Volumes of production are coordinated directly by the central organization or farm owner based on orders given by foreign buyers. In those organizations with multiple farm sites, the managers of different butterfly farms are employees of the larger organization. These governance structures tend to be more corporate in fashion, though single-owner farms as present in Ecuador and El Salvador combine their business with a socially and environmentally responsible component.

In other cases, the coordination of production is more atomistic, relying on the coordination between independent butterfly farms of

various sizes and a central organization or NGO project that buys from farmers and manages trade with foreign buyers. We can distinguish between two different forms of this type of model. One model relies heavily on what Gereffi et al. (2005) characterize as relational forms of governance, in which complex forms of interactions and mutual dependence arise based on reputation, repeated interaction, or family/ethnic ties bind parties together. Probably the best (and perhaps only) example of this is the Costa Rica Entomological Society (CRES). CRES works with a network of roughly 90 farmers who have developed long-term relationships with CRES and where such interactions have helped to foster an expertise and knowledge of the market among CRES's entire network of farmers that is unique within the sector. Access to this network is tightly controlled, with CRES working to maximize returns given to its farmers. Consequently, farmers working with CRES generally receive higher prices than other butterfly farmers in Costa Rica (personal communications, Oct. 2012).

The other model of organization is what Gereffi et al. (2005) term as captive governance, where smaller suppliers rely heavily on larger buyers to coordinate trade. In this model, present in other parts of Costa Rica and particularly in East Africa, companies, NGOs, or development projects have established networks of small butterfly farms that supply these organizations with pupa for export. Farmers in these networks are captive in the sense that they typically receive the highest price for pupa from the organizer, though in some cases (e.g., Kenya), farmers often sell outside of the network albeit at a discount.

A particular problem in the captive model of governance is that supply is often poorly coordinated relative to demand, leading to oversupply of pupa and discouraged suppliers. The terms of farm sales illustrate some of these issues. For instance, one of the larger projects in Tanzania aims to provide farmers with 65 percent of the export price, but often only buys one-half of the supply offered to the project (Morgan-Brown 2006; personal communications, July 2012). As exports are around 1,000 pupa per week, the rejection of an additional 1,000 pupa, valued at US$1 each, suggests the opportunity cost of the rejections is over US$50,000 per year. By contrast, another project in Tanzania contracts to buy all pupa from farmers, with export rejections placed in its butterfly exhibition (personal communications, July 2012). While this reduces risks for farmers, it merely shifts these to buyers to find markets for all purchased butterflies, whether for export or through local tourism (e.g., local butterfly gardens), as well as the cashflow required for sustaining such types of purchases. In both Kenya and Tanzania, while farm networks for local buyers are extensive, only a few farmers are consistently active in the trade, with many farmers only involved on an *ad hoc* basis. Moreover, little in the way of market information is provided to farmers, leaving them quite vulnerable to changes in market conditions. Indeed, the largest project in Tanzania saw its base of farmers fall by nearly two-thirds after the

airfreight issue emerged in 2010 (personal communications, July 2012). An additional issue is that many butterfly projects that began as NGOs or development projects have organizational difficulties in making the transition to being a for-profit business and institutionalizing decision-making processes (personal communications, July 2012).

From these different supply bases, sales of pupa are made to one of two different channels in Europe or the United States. In general, large brokers handle the majority of sales (recall figure 1). The two main brokers in the butterfly trade are LPS in the United States and Stratford Butterfly Farm in the UK. These brokers assemble pupa shipments from throughout the world and send pupa to different exhibitions in the United States and Europe. Typically, shipments made to exhibitions are a mix of Asian (50 percent), Near Tropics (35-40 percent), and African (10-15 percent), with sales made on a weekly or bi-weekly basis depending on the size of the order (personal communication, Oct. 2012). Most sales from Africa, Ecuador, Malaysia, the Philippines, Suriname, and Belize are handled via brokers. In El Salvador, about half of sales are made directly, while the rest are handled via brokers. A few suppliers, most notably CRES, send pupa directly to exhibitions, while a minority of sales are handled by smaller brokers, mainly sales from Latin America to Europe (personal communications, October 2012 and November 2012).

As noted earlier, the change in freight rules has resulted in a significant consolidation in the market, with many smaller brokers leaving the market (personal communications, October 2012). There was some concern expressed among interviewed suppliers about the consolidation in buyers, although one of the East African suppliers remarked on the continued patience that Stratford has had with quality and distribution from East Africa to Europe (personal communication, July 2012).

Challenges for the global butterfly trade

The global butterfly trade is in a tenuous state of stasis. At present, global supply for export and demand are roughly balanced. The shipping crisis of 2010 led to a number of smaller suppliers in South Asia and Africa exiting the market and reaffirming the dominance of larger players in East Asia and Central America that can more cost-effectively provide large volumes to European and American exhibitions. On the demand side, there has been relatively weak growth in the number of global exhibitions over the past few years, particularly due to the financial crisis, though prospects for the future exist in the Middle East, Russia, and China (personal communication, February 2013). In East Africa, there is hope for a new exhibition in Mombasa to serve as a possible display hub and market for East Africa butterflies (personal communication, July 2012). Nonetheless, given that existing suppliers could meet new demand easily, the prospects for new players in the sector are limited. Indeed, countries like India, which does not allow the export of any of its fauna at present, would be hard pressed to compete with suppliers in the Philippines on price and species diversity, while other countries such as Peru, which dominates the deadstock market, does not offer species that are that unique relative to other Latin American suppliers (personal communication, October 2012). While niches for certain species do exist, in general, new entrants will have to meet buyer demands that butterflies are "big, pretty, cheap, easy to maintain, and common" (personal communication, October 2012). Conversely, any niches that could emerge are likely too small and limited in scope relative to existing supplies. The potential for new, conservation-based projects based on butterfly farming in the future is likely to be limited given current governance patterns. On the margin, and at local levels, an expansion of butterfly farming could have some positive impacts, particularly those farms linked with local tourism, though the range of beneficiaries is likely to be small. On the other hand, those oriented exclusively towards export markets are much less likely to be viable, even if demand rises significantly, unless they can provide something significantly different than existing offerings. As many species do not breed well in captivity, the universe from which should new, niche supply could come from is likely to be limited.

A more pressing issue in the current construct of the industry concerns the management of butterfly production in the captive governance model found predominately in East Africa but also in many NGO and development-led butterfly farming projects. As noted earlier,

the organization of these models fails to adequately equip farmers with information on external conditions and demand, with farmers largely producing what they can and hoping to sell as much as possible, rather than closely working with farmers and mentoring their skills and production capacity in a more sustainable manner. Many of these development projects are often designed to be scalable, involving many farmers and communities, and thus making it difficult to restrict the number of participating farmers for a host of equity reasons. In the absence of developing a relational governance model such as the one found at CRES, which takes considerable effort and social capital to develop, such projects could potentially be better managed by implementing market-based incentives for the production and trade of butterflies between farmers and buyers.

One such way this could be done is through an instrument known as an individually transferable quota, or ITQ, conceived as a means to control open-access resources such as fisheries (Gordon 1954; Scott 1955). ITQs are similar to methods proposed in the environmental economics literature to control pollution (e.g., "cap-and-trade" policies), relying on the development of property rights and markets to internalize the externality associated with the right to pollute (Crocker 1966; Dales 1968; Montgomery 1971). ITQs are different than some types of production quotas found in many agricultural commodities (see e.g. Babcock 1990; Dawson 1991; or Colman 2000), in the sense that quota rights can be traded, with the aim to commoditize production rights as a means to limit overproduction (McCay 2004). ITQs have been successfully implemented in many fisheries to arrest the decline of wild stocks. Chu (2009) found improvements from the use of ITQs in 12 of 20 the stocks studied. In a meta-review of over 11,000 fisheries, Costello et al. (2008) found that ITQs more often reversed trends of stock decline relative to other forms of management. They further noted that proportion of ITQ-managed fisheries that collapsed was one-half the proportion of those not using ITQs.

Under an ITQ system, each year an annual quota of fish is established, with individual fishermen given a share of the quota based on past production (Aranson 1990; Grafton et al. 2006). However, it is possible to allocate ITQs by other means, such as through auctions or by community-based approaches (Wingard 2000). Trade is allowed, with quota-holders provided the right to trade their production rights to those that wish to increase production. Consequently, ITQs remove the "commons" problem associated with overfishing by creating a market for the right to fish (Aranson 1990; Sumalia 2010). At the same time, while ITQs can improve the management of fisheries, there can also be equity issues to resolve. In particular, ITQs can lead to consolidation of production and greater market power for larger producers at the expense of smaller ones (Grafton et al. 1996; Sumalia 2010). Some of these types of problems can be resolved through different mechanisms to allocate quota rights, whether through communities, auctions, or

limiting the size of individual quota rights that can be obtained (Sumalia 2010; Wingard 2000). There can also be problems with "highgrading" in which lower valued fish that are caught are thrown back at sea, with only high-valued fish caught and applied towards the quota and thus putting pressure on the viability of the natural stock of certain species (Anderson 1994).

How could ITQs be adapted in small-scale butterfly farms? Butterfly production is different than fisheries in the sense that overproduction would not deplete natural stocks of butterflies. However, one of the major challenges in butterfly production is relatively constant demand with increasing numbers of potential suppliers, particularly in those butterfly farms in Africa that involve hundreds of farmers in their systems. A quota system that allocated production rights to participating producers and allowed smaller farmers the right to earn money through the trading of quota rights could not only reduce losses and overproduction, but could also improve the stability of income for all involved in the sector. Rich (2014), adapting an ITQ model of Garrity (2011), highlights these positive dynamics in a simulation model of smallholder butterfly farming, and demonstrates different means by which quotas could be allocated in more equitable ways.

Conclusions

Over the past thirty years, butterfly farming has proved to be a unique vehicle for enhancing the preservation of the environment and biodiversity. By giving butterflies a monetary value and establishing a vibrant international market for their trade and display, butterfly farming has notably improved the management of local forests in many developing countries and given livelihoods opportunities to the poor, of which many of whom would be unable to find other opportunities in their communities. At the same time, the market for butterflies is rapidly maturing, with opportunities for new entrants relatively limited, particularly on the export side. Moreover, existing production, particularly that which is smallholder based, could be enhanced through institutional innovations that would tighten the governance and coordination of these systems. By highlighting and distinguishing between the governance mechanisms that exist within this under-researched sector, our paper has provided guidance on current constraints and mechanisms through which such improvements could be realized.

While we are somewhat skeptical on the potential for increased butterfly farming for export, we do see particular scope for expanding the mechanism of monetizing and valuing butterflies more generally as a means of protecting the environment. We mention two ways in particular. First, the expansion of butterfly gardens at a local level could further raise public awareness for conservation and provide opportunities for a range of disadvantaged groups (see Rich et al. 2014 for an example of this). In many developing countries, general awareness of environmental protection is low. Butterfly gardens are a relatively low-cost way of communicating the need for conservation and target younger generations that are more likely to uptake this message. Furthermore, as with butterfly farming, butterfly gardens can employ vulnerable members of society in developing countries, such as the disabled, giving them both a livelihoods as well as an important role as an environmental steward.

Second, integrating butterflies and their conservation within traditional agricultural production practices or as a side activity (e.g. butterfly gardens) could be a way for various types of producers to both add value to production, whether through branding or local tourism for example, while simultaneously serving as stewards for the environment. Producer-led eco-labeling programs that highlight the protection of local biodiversity could be one means to elicit consumer response by environmentally conscious segments of society that care about specific species (Chengappa et al. 2014). As the presence of

butterflies in an ecosystem represents a useful, low-cost signal of a healthy environment, their use as both a performance measure and symbol that communicates to consumers the conservation efforts made by producers, and could be utilized as a means to add value to producers engaged in sustainable production practices. In this fashion, we could consider the use of butterflies or other types of biodiversity promotion as a new, private sector led means of payments for environmental services, or PES (Pagiola 2008). While current PES provides an incentive mechanism for producers to adopt more sustainable land use and production practices, communicating these practices to consumers and other actors in the value chain can be problematic and threaten the positive efforts made by producers. Furthermore, PES programs are overwhelmingly funded by government or donor organizations, with sustainable private sector led funding mechanisms largely absent (Milder et al. 2010). In this context, linking PES with financial and communication mechanisms that add value for producers, and shift the burden of payment from government to consumers who are willing to pay for such goods, could be a more sustainable way of valuing butterflies in the future.

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