Biological Conservation 190 (2015) 80–86

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Heterogeneity in consumer preferences for orchids in international trade and the potential for the use of market research methods to study demand for wildlife

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ARTICLE INFO

Article history:
Received 20 February 2015
Received in revised form 11 May 2015
Accepted 19 May 2015
Available online 12 June 2015

Keywords:
Anthropogenic allee effect
Consumer research
Horticulture
Latent Class Models
Over-collection
Plant conservation
Rarity
Wildlife trade

ABSTRACT

The demand for wildlife products drives an illegal trade estimated to be worth up to $10 billion per year, ranking it amongst the top transnational crimes in terms of value. Orchids are one of the best-selling plants in the legal horticultural trade but are also traded illegally and make up 70% of all species listed by the Convention on the International Trade in Endangered Species (CITES). To study consumer preferences for horticultural orchids we use choice experiments to survey 522 orchid buyers online and at large international orchid shows. Using latent class modelling we show that different groups of consumers in our sample have distinct preferences, and that these groups are based on gender, genera grown, online purchasing and type of grower. Over half of our sample, likely to be buyers of mass-produced orchids, prefer white, multi-flowered plants. Of greater conservation interest were a smaller group consisting of male hobbyist growers who buy their orchids online, and who were willing to pay significantly more for species that are rare in trade. This is the first in-depth study of consumer preferences in the international orchid trade and our findings confirm the importance of rarity as a driver of hobbyist trade. We show that market-research methods are a new tool for conservationists that could provide evidence for more effective conservation of species threatened by trade, especially via campaigns that focus on demand reduction or behaviour change.

1. Introduction

The illegal trade in wildlife is one of the highest value transnational organised crimes, with an estimated worth of $7 to $10 billion per year that makes it more lucrative than illicit diamond trafficking and the small arms trade (Haken, 2011). Many wildlife products also have a legal trade, the total value of which is around $249 billion annually, which includes the $222 billion fish and timber trades (Engler and Parry-Jones, 2007) and $27 billion of trade in species for other markets, including for medicine, food and pets (Broad et al., 2003). Although smaller, the illegal trade is of significant conservation concern due to threats from over-harvesting and the wider implications of 'by-catch' of non-target species (Broad et al., 2003), the spread of diseases (Gómez and Aguirre, 2008), as well as security concerns from the growth of organised crime syndicates (Haken, 2011). For these reasons, efforts to tackle wildlife trade are a conservation priority and take many forms, a diversity of which is required to tackle an often secretive and evolving threat (Broad et al., 2003). International legislation to control wildlife trade takes the form of the 1975 Convention on the International Trade in Endangered Species (CITES). CITES aims to monitor and restrict trade in the 35,497 species and 71 subspecies of animals and plants that are listed on one of its three appendices (CITES, 2013). In addition to legislation, 'supply-side' methods target producers by attempting to reduce market prices for illegal wildlife, for example by flooding the market with sustainable or farmed alternatives (Bulte and Damania, 2005). At the opposite end of the trade chain, 'demand side' methods focus on reducing consumer demand, through targeted educational or high profile media or marketing campaigns (Broad et al., 2003; Williams et al., 2012; Coghlan, 2014; United for Wildlife, 2014). However, in spite of this recognised importance of demand there still exists a relatively poor understanding of factors that influence it, such as consumer preference for different products.

Here we present the first study aiming to address this shortfall in knowledge by testing a novel method for understanding the characteristics of wildlife products that are preferred by different

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http://dx.doi.org/10.1016/j.biocon.2015.05.010
0006-3207/

groups of buyers. We use orchids as our case study as they are the largest taxonomic group listed by CITES. All 26,000 known species of orchid are listed by the convention, making up 9.8% of Appendix I, 73% of Appendix II and 70% of total CITES species (CITES, 2013). Orchids are particularly susceptible to over-collection from trade due to naturally small populations and high sensitivity to other threats, such as habitat degradation (Koopowitz, 2001). Large-scale over-harvesting of wild orchids has been recorded to supply the medicinal (e.g. Traditional Asian Medicine: Liu et al., 2014), edible (e.g. Salep in Iran: Ghorbani et al., 2014) and horticultural (e.g. *Bulbophyllum* spp.: Vermeulen et al., 2014) trades. At greatest risk are those species listed on CITES Appendix I, including all *Paphiopedilum* and *Phragmipedium* species, part of the group known as slipper orchids that are extremely popular in horticultural trade. Over-collection of slipper orchid species has resulted in the decline of wild populations, species extinctions and, in the case of *Phragmipedium kovachii* smuggled to the US from Peru, even disputes between nations over sovereignty of natural resources (Averyanov et al., 2003, 2010; Pittman, 2012). Although not all orchids are threatened by trade, the entire family was included on CITES due to the difficulty that non-experts face in discriminating between closely related species.

We focus on the orchid horticultural trade in particular as it is the most diverse market in terms of consumers and species sold and has both a well-developed legal trade and an illegal trade, which has been linked to the decline of orchids in the wild (Averyanov et al., 2003; Vermeulen and Lamb, 2011). The orchid horticultural trade dates back over 2 000 years in China and Japan (Paek and Murthy, 2002) and reached a peak in the nineteenth century when wealthy European collectors suffering from 'orchidelirium' imported large quantities of wild plants from around the world (Pittman, 2012). Today orchids are no longer just for the rich, as improvements in horticultural technology have made mass-produced hybrids of a few genera one of the top selling pot plants in the world (FloraHolland, 2013; USDA, 2014). In addition, there still exists a smaller specialist market, where hobbyists in an international network of orchid societies grow a wider range of species and hybrids. Finally, growing domestic markets in Latin America, China and Southeast Asia may include hybrids and species sold to both specialist and non-specialist consumers (e.g. Phelps and Webb, 2015). It is the latter two markets that have been linked to over-harvesting of wild plants for trade due to collection for sale at local markets or international orchid shows, orders from buyers for specific species, or from nursery owners hoping to incorporate desirable wild traits into new hybrids (Pittman, 2012; Phelps and Webb, 2015). Whilst trade in wild-collected plants at markets in tropical regions has been the focus of some research (e.g. Flores-Palacios and Valencia-Diaz, 2007; Phelps and Webb, 2015), little attention has been paid to the study of the conservation implications of the formal international orchid trade. Here we aim to address this shortfall in knowledge by focussing our study on important orchid buying countries including Japan and the UK.

To investigate preferences we use choice experiments, a stated preference method with its origins in economic consumer theory, which states that a preference is not for a product itself but for the characteristics that it possesses (Lancaster, 1966). This theory, combined with random utility modelling (McFadden, 1980), assumes that consumers will choose to buy the product with the characteristics that offer them the highest utility. Choice experiments also enable researchers to measure a respondent's Willingness to Accept (WTA) compensation or Willingness to Pay (WTP) a premium for different characteristics of a product. After extensive use in the marketing and transport sectors, choice experiments have been adopted in other fields, such as agriculture (e.g. Birol et al., 2009), environmental planning (e.g. Hanley et al., 2003) and conservation (e.g. Verissimo et al., 2014). They have also been used to study consumer preferences for mass-market orchids in Hawaii, a major producer and consumer of pot-plant orchids (Palma et al., 2010). In this study we use choice experiments to assess consumers' preferences and WTP for horticultural orchids, with the dual aims of understanding which characteristics make certain species particularly 'tradable' in this market, and identifying consumer groups who may be most likely to buy wild-collected plants

2. Methods

2.1. Choice experiment design and pilot study

We ran an online focus group of hobbyist growers to identify 10 attributes that were important to their buying decisions. These were used to create two experimental designs of 29 choice sets each, one focussing on physical characteristics of the flower (e.g. colour, shape) and the second on general plant characteristics (e.g. species or hybrid, rarity in trade) of orchid plants. We used an orthogonal design to ensure that there was statistically no correlation between attributes, and each experiment was split into three blocks (Hensher et al., 2005). We used these designs to survey 103 randomly selected visitors to the 2012 UK Peterborough International Orchid Show. Feedback on survey design, attributes and levels was gathered following each survey.

Using a combination of the significantly preferred attributes (see Table 1) from both pilot surveys, the main survey was designed using Ngene (version 1.0.1, ChoiceMetrics, Sydney, Australia), to produce a D-efficient Bayesian design (Jaeger and Rose, 2008). We chose this design type as it maximises statistical efficiency in estimating preference parameters by minimising D error over the prior distribution of the parameters while accounting for uncertainty (Jaeger and Rose, 2008). To allow for uncertainty, we used 500 Halton draws from normal distributions for each parameter prior distribution. We then compared the mean Bayesian Dp error of over 50,000 Bayesian designs, selecting the one with the lowest error at 0.171. This design had 12 choice sets, one of which is shown in Fig. 1. The design was attribute balanced,

Table 1
Attributes and attribute levels of orchids used in the final choice experiment.

Attribute	Levels	Description
Flower colour	Red White Blue Yellow Green Black	Primary flower colour. Respondents were asked to ignore any possible secondary colours or patterns. Colours chosen to represent a range of orchid flower colours, based on complementary colour theory.
Frequency in trade	Rarely found for sale Frequently found for sale	References to wild plants were not included due to concerns of sensitivity following feedback during the pilot study, with 'rarity in trade' used to capture preferences for novelty whilst minimising social-desirability bias.
Number of flowers	Single flower Multiple flowers	The number of flowers present on the plant.
Species/ Hybrid	Species Hybrid Complex Hybrid	Whether the plant is a species, a hybrid or a complex hybrid (result of breeding hybrids together, or hybrids with species).
Price	$15 $30 $45 $75 $105 $150	Range based on upper and lower limits of orchid prices found on general sale online and at orchid shows. US$ used to provide continuity across different survey areas. Simple currency converter provided to each respondent.