

Kent Academic Repository

Full text document (pdf)

Citation for published version

Hinsley, Amy and Nuno, Ana and Ridout, Martin and St. John, Freya A.V. and Roberts, David L. (2016) Estimating the extent of CITES noncompliance among traders and end-consumers; Lessons from the global orchid trade. *Conservation Letters*, 10 (5). pp. 602-609. ISSN 1755-263X.

DOI

<https://doi.org/10.1111/conl.12316>

Link to record in KAR

<http://kar.kent.ac.uk/58302/>

Document Version

Publisher pdf

Copyright & reuse

Content in the Kent Academic Repository is made available for research purposes. Unless otherwise stated all content is protected by copyright and in the absence of an open licence (eg Creative Commons), permissions for further reuse of content should be sought from the publisher, author or other copyright holder.

Versions of research

The version in the Kent Academic Repository may differ from the final published version.

Users are advised to check <http://kar.kent.ac.uk> for the status of the paper. **Users should always cite the published version of record.**

Enquiries

For any further enquiries regarding the licence status of this document, please contact:

researchsupport@kent.ac.uk

If you believe this document infringes copyright then please contact the KAR admin team with the take-down information provided at <http://kar.kent.ac.uk/contact.html>

LETTER

Estimating the Extent of CITES Noncompliance among Traders and End-Consumers; Lessons from the Global Orchid Trade

Amy Hinsley¹, Ana Nuno², Martin Ridout³, Freya A.V. St John¹, & David L. Roberts¹¹ Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Kent, Canterbury CT2 7NR, UK² Centre for Ecology and Conservation, College of Life and Environmental Sciences, University of Exeter, Cornwall Campus, Penryn, Cornwall TR10 9EZ, UK³ School of Mathematics, Statistics & Actuarial Science, University of Kent, Kent, Canterbury CT2 7NR, UK**Keywords**

Conservation policy; illegal behavior; item count technique; list method; online survey; ornamental plant trade; plant conservation; wildlife trafficking.

Correspondence

Amy Hinsley, Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Kent, Canterbury CT2 7NR, UK.
E-mail: a.hinsley-785@kent.ac.uk

Received

16 June 2016

Accepted

23 September 2016

Editor

Edward Webb

doi: 10.1111/conl.12316

Abstract

The Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES) regulates trade in over 35,000 species, over 70% of which are orchids. To investigate rule-breaking behavior among traders and buyers in a specific international wildlife trading community, we used direct questions (DQs) and the unmatched count technique (UCT) to survey the orchid growing community about CITES compliance and their knowledge and opinions of the rules. In DQ, 9.9% had smuggled, 4.8% had laundered, and 10.8% had been sent orchids from online purchases without paperwork; UCT estimates did not differ significantly. Growers with greater knowledge of CITES rules were more likely to break them, and there were widespread negative views of CITES among respondents. We recommend targeted enforcement focusing on both online trade and at the point of import, coupled with efforts to encourage traders and end-consumers to engage with discussions on CITES rule implementation

Introduction

The international wildlife trade is a lucrative market involving thousands of species. Well-managed trade can be sustainable, but monitoring and regulation are essential, as unsustainable and illegal trade can threaten species, affect the livelihoods of communities dependent upon those resources, and strengthen organized criminal networks (Haken 2011; South & Wyatt 2011). National and international policy may prohibit the trade in certain species, set export quotas, or restrict the source of wildlife permitted in trade. The primary international wildlife trade legislation is the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), which regulates trade in over 35,000 species (CITES 2013). Species are listed by governments when trade poses a direct threat or adds pressure to vulnerable

wild populations, or as a “lookalike” of a listed species, to aid enforcement of the Convention (CITES 2013). While CITES and corresponding national legislation can successfully control trade (Doukakis *et al.* 2012), the continued illicit trade in many listed species has called into question its effectiveness (Challender & MacMillan 2014). A better understanding of conservation rule-breaking and illegal activity is an important step toward encouraging compliance (Solomon *et al.* 2015), and improving knowledge on noncompliance has been noted as a priority to strengthen CITES (Phelps *et al.* 2010). However, social desirability and threat of prosecution can make people unwilling to discuss their involvement in noncompliance.

To identify potential drivers of noncompliance and provide recommendations for policy implementation, we present the first study of CITES noncompliance among traders and buyers in a specific international

wildlife trading community. We choose orchids as a case study, a group that comprises approximately 73% of CITES-listed species and 9.8% of Appendix I (CITES 2013), meaning any transnational trade of orchid species must comply with the Convention's rules (CITES 2004). Orchids are also protected from wild-collection and trade under national policy in many countries (e.g., Commonwealth of Australia 2015). Between 1997 and 2014, reported seizures of illegally traded orchids resulted in fines of up to \$257,000 and prison sentences of up to 6 years, although punishments were reported in few cases (TRAFFIC 2014). Although orchid hybrids are top-sellers in mass-market trade (USDA 2015), there exist specialist collectors who demand rare species (Hinsley *et al.* 2015), which can lead to overcollection and trade that can threaten species (Thomas 2006). Highly demanded groups such as tropical Asian slipper orchids *Paphiopedilum* spp. are particularly at risk, with many species threatened with extinction due to collection or trade (IUCN 2015). These factors make the orchid trade analogous in many ways to other wildlife trades, such as those with parallel legal and illegal markets (e.g., fur: Wyatt 2009; reptiles: Auliya *et al.* 2016) and those with coexisting mainstream and specialist consumers (e.g., songbirds: Jepson & Ladle 2009).

We use an online questionnaire to gather data on knowledge and opinions of CITES, and prevalence of CITES noncompliance among orchid growers. As non-compliance is illegal, we use a specialized questioning method, the unmatched count technique (UCT) to encourage truthful reporting (Nuno & St John 2015). In UCT, respondents are presented with a list of statements and asked to report the total numbers that apply to them. This is either a control list of innocuous “non-sensitive” statements or a treatment list with the control items plus an additional “sensitive” statement (Figure 1). In conservation, UCT has been used to study behaviors such as unauthorized hunting (Nuno *et al.* 2013) and forest resource use (Harrison *et al.* 2015). However, in order to assess suitability of different techniques, a better understanding of the limitations of these methods in different conservation contexts is essential but underresearched (Nuno & St John 2015). We employed both direct questions (DQs) and UCT to explore potential trade-offs between techniques, with a focus on statistical efficiency and comparison of study findings.

Methods

We designed pilot and final questionnaires using www.SurveyGizmo.com, which were translated into French, German, Indonesian, Japanese, Malaysian, and

Spanish and checked by native speakers with orchid expertise. Final survey links were emailed to all hobbyist societies listed in the American Orchid Society and British Orchid Grower's Association 2014 Directories, and to national or regional hobbyist organizations in Australia, Canada, Europe, Japan, Latin America, South Africa, and Southeast Asia. The pilot survey was sent to a subset of societies.

Pilot study

UCT lists should be carefully constructed, as poorly designed control lists can cause bias (Glynn 2013). A mixture of high and low prevalence statements reduces the likelihood of respondents agreeing with all or zero items, an outcome that removes the protection that UCT provides and decreases the likelihood of truthful answers by rule-breakers (Droitcour *et al.* 1991). Further, negatively associated statements reduce the variability of answers, increasing statistical efficiency (Glynn 2013). We piloted 32 control statements to assess their prevalence (see Supporting Information); all were related to orchid growing to ensure that the sensitive statement did not stand out (Glynn 2013). We asked respondents to select all true statements and provide feedback. Statement order was randomized for each respondent to avoid presentation order bias. We calculated the prevalence of each statement (% of respondents selecting it) and association between all pairs of statements, using chi-squared and odds ratio tests.

Main survey questions

Based on observations of the orchid community and consultation with the UK CITES Scientific Authority, we constructed statements to investigate four sensitive behaviors:

- Smuggling (“I have personally sent or carried an orchid across an international border without obtaining the required CITES paperwork”);
- Laundering (“I have personally sent or carried an orchid across an international border using the wrong CITES paperwork for that plant [e.g. paperwork for a different species]”);
- Buying online (“I have bought an orchid online that was sent to me without the correct or required CITES paperwork”);
- Wild plants (“I have an orchid in my collection that I know or strongly suspect was wild-collected”).

These range in sensitivity from active CITES rule-breaking (“smuggling” and “laundering”) to passive

Please read the following statements and tell us how many are true for you. You do not need to tell us which statements are true for you, just the total number.

(50% of respondents see list 1, 50% see list 2)

List 1: Control

- a) I have at least one *Phalaenopsis* in my collection
- b) I specialize in growing fewer than five orchid genera
- c) I estimate that I currently have more than 50 orchid plants
- d) I have never bought orchids online

List 2: Treatment

- a) I have at least one *Phalaenopsis* in my collection
- b) I have an orchid in my collection that I know or strongly suspect was wild-collected
- c) I specialize in growing fewer than five orchid genera
- d) I estimate that I currently have more than 50 orchid plants
- e) I have never bought orchids online

How many of these statements are true for you?

Figure 1 Example of an unmatched count technique question used in this survey to ask about ownership of wild-collected plants. Respondents were randomly assigned by survey software to view either list 1 or list 2 and gave their answer from a dropdown menu of 0–4 for list 1 and 0–5 for list 2.

(“buying online”), and finally socially undesirable but not necessarily illegal (“wild plants”). We included these statements in four UCT treatment lists (Figure 1). Respondents answered all four questions but were randomly assigned by SurveyGizmo to either the control or treatment list for each. All respondents then answered each sensitive statement in a DQ.

Respondents were asked to rate their knowledge of CITES orchid rules on a five-point Likert scale, and presented with an open-text question about their opinions on the efficacy of the CITES for orchid conservation (see Supporting Information). All UCT questions required an answer before respondents could continue the survey; other questions could be skipped but were not marked as optional.

Analysis

We analyzed data using R version 3.2.1 (R Core Team, 2015) and, unless specified, the list package version 8.0 (Blair & Imai 2010) designed specifically to analyze UCT.

We used Blair & Imai’s (2010) test for design effects to investigate the assumptions of the UCT that the presence of the sensitive item does not influence answers to the control items, and that the treatment group is randomly assigned.

For each behavior, we calculated a prevalence estimate for DQ (proportion of people admitting to behavior) and UCT (difference in mean between treatment and control groups). Associations between answers to each pairwise

Table 1 Pilot and final results for the control list of each of the four UCTs, showing list mean and proportion of respondents giving each answer (e.g., “4 of the statements apply to me”)

	List mean	% “0”	% “1”	% “2”	% “3”	% “4”
Pilot						
Smuggling	1.6	4.9	42.7	36.8	14.5	0.7
Buying online	1.8	4.7	25.0	52.2	16.7	0.7
Wild plants	1.9	4.7	21.3	50.0	21.3	1.5
Laundering	1.9	3.9	22.6	54.7	17.1	0.0
Final						
Smuggling	2.2	1.3	22.2	38.6	28.1	9.8
Buying online	2.1	1.4	21.3	48.5	23.0	6.0
Wild plants	2.3	1.2	10.8	52.8	30.1	5.1
Laundering	2.3	0.5	9.1	49.6	38.3	2.5

DQ combination were calculated using chi-squared and odds ratio tests.

To estimate the prevalence of sensitive behavior as a function of respondent characteristics, we fitted logistic regression models to the DQ response and ordinary linear models to the UCT score. Demographic variables and self-assessed knowledge scores were included as potential covariates, while interactions of the group variable (treatment or control) with each potential covariate were also included for UCT models. We selected, ranked, and averaged the most parsimonious models (with corrected Akaike’s information criterion: AICc) using the MuMin package v.1.13.4 (Barton 2015), considering only models with interactions for the UCT. Models with $\Delta AICc < 4$ were used for final model averaging (Burnham & Anderson 2002).

Table 2 Matrix of statement prevalence and association between different statements used to design the control list used in the “Laundering” UCT

	Prevalence	Odds ratios (>1 = +ve association; <1 = -ve association)			
		I own at least one field guide to wild orchids	I have never been to an orchid show	The majority of my orchids are hybrids	I use fertilizer on my orchids
I own at least one field guide to wild orchids	60.5	NA	1.1	0.4	0.9
I have never been to an orchid show	3.4	1.1	NA	0.4	0.1
The majority of my orchids are hybrids	37.3	0.4	0.4	NA	2.0
I use fertilizer on my orchids	88.0	0.9	0.1	2.0	NA

Shading denotes significance at $P \leq 0.05$.

The frequency of each self-knowledge level was calculated and opinion statements were manually categorized into “positive,” “negative,” and “neutral.”

Results

Pilot study

We received 409 completed pilot surveys, mainly from hobbyists (86.6%), with a small number of casual (14.9%) and professional growers (5.6%) in the UK (31.1%), United States (22.1%), and Japan (18.6%). Statement prevalence ranged from 88.0% (“I use fertiliser on my orchids”) to 1.2% (“I have been growing orchids for less than one year”), and 102 statement pairs showed significant negative association (see Supporting Information). Four UCT lists were constructed with means between 1.6 and 1.9 for use in the final experiment (Table 1). The control statement list for the “laundering” UCT demonstrates the combination of low and high prevalence, and negatively and positively associated statements (Table 2).

Main study

In total, 1,354 people started the survey, with most survey abandons occurring at the first UCT ($n = 144$) or the DQ page ($n = 129$). We used data from respondents who completed all UCT, DQ, and main demographic questions ($n = 814$) for the multivariate analyses, of which 56.4% ($n = 459$) were males and the mean age was 60.2 (SD 14.1) (see Supporting Information).

No UCT showed design effects and three had random assignment; the “buying online” UCT had significantly more males in the treatment group ($P < 0.01$) (see Supporting Information). Strong positive associations between answers to all DQ pairs (all $P < 0.01$) suggested the same respondents broke several rules, rather than rule-breaking being widespread throughout the sample.

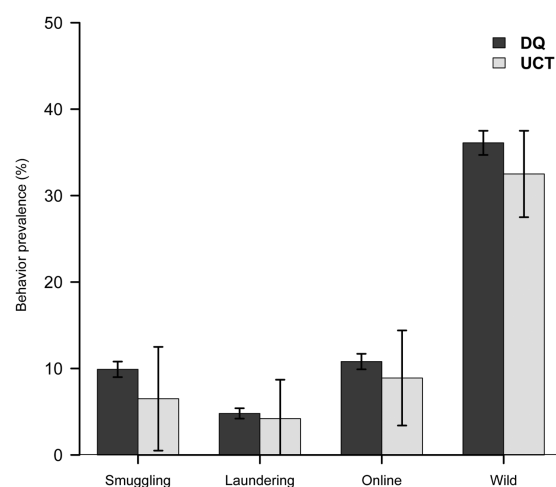


Figure 2 Direct question and unmatched count technique prevalence estimates of all four behaviors: smuggling plants, laundering plants, receiving online purchases sent with no paperwork, and owning wild-collected plants.

The DQ found that 9.9% of respondents had smuggled, 4.8% had laundered, and 10.8% had received orchids from an online purchase without required paperwork. UCT estimates did not differ significantly (Figure 2). In the multivariate analysis with the exception of “Latin America,” “*Paphiopedilum*,” and “*Phragmipedium*,” all covariates were significant predictors of answers to at least one DQ (Table 3). The UCT produced fewer significant covariates for all behaviors, even at 90% confidence intervals (Table 4). Australian respondents were more likely to admit to smuggling via UCT than DQ.

Of 893 respondents who self-rated their CITES knowledge, 38.7% ($n = 346$) rated it as “good” or “complete,” and 40.8% ($n = 264$) as “no” or “some” (see Supporting Information). Of respondents who gave opinions regarding CITES ($n = 649$), 61.2% ($n = 397$) reported negative and 21.0% ($n = 136$) reported positive views. Positive opinions were generally short with little detail (e.g.,

Table 3 Summary effects of potential predictor variables on estimated prevalence of sensitive behavior in the direct questions (DQs)

Covariate	Level	Smuggling DQ	Laundering DQ	Buying online DQ	Wild plants DQ
		Est. (SE)	Est. (SE)	Est. (SE)	Est. (SE)
(Intercept)		-4.13 (0.48)	-5.20 (0.74)	-4.91 (0.86)	-2.93 (0.52)
Country	UK	0.35 (0.37)	0.16 (0.52)	0.31 (0.39)	-0.73 (0.28)
	EU	2.19 (0.40)	1.60 (0.51)	2.06 (0.41)	0.92 (0.34)
	Australasia	-0.46 (0.48)	0.55 (0.50)	-0.35 (0.43)	0.90 (0.24)
	L. America	-0.04 (0.60)	-0.39 (0.82)	0.02 (0.60)	0.02 (0.39)
	Other	1.54 (0.40)	0.88 (0.54)	0.88 (0.44)	2.24 (0.40)
Knowledge	>median	0.74 (0.28)	1.12 (0.41)	0.06 (0.27)	0.42 (0.18)
Experience	>median	1.79 (0.32)	1.86 (0.47)	1.98 (0.31)	0.91 (0.19)
Gender	Female	-0.42 (0.30)	-0.22 (0.41)	-0.78 (0.31)	-0.85 (0.19)
No. genera	>median	0.40 (0.31)	-0.35 (0.35)	0.46 (0.32)	0.61 (0.20)
Grow <i>Phragmipedium</i> ?	Yes	0.28 (0.30)	-0.11 (0.37)	-0.13 (0.32)	0.09 (0.21)
Professional	Yes	0.35 (0.41)	1.08 (0.47)	0.96 (0.46)	1.43 (0.43)
Grow <i>Paphiopedilum</i> ?	Yes	0.15 (0.37)	-0.20 (0.40)	0.52 (0.36)	0.09 (0.25)
Hobbyist	Yes	0.23 (0.51)	0.64 (0.61)	1.57 (0.68)	1.47 (0.47)
Age	>median	0.01 (0.27)	-0.07 (0.36)	-0.62 (0.28)	0.01 (0.18)

Shading denotes significance, all at $P \leq 0.05$.

Reference levels: U.S.; < median knowledge; no experience; male; < median genera; do not grow *Phragmipedium*; nonprofessional; do not grow *Paphiopedilum*; nonhobbyist; < median age (see Supporting Information for relative variable importance and confidence intervals).

Table 4 Summary effects of potential predictor variables on estimated prevalence of sensitive behavior in the unmatched count technique (UCT) experiment

Covariate	Level	Smuggling UCT	Laundering UCT	Buying online UCT	Wild plants UCT
		Est. (SE)	Est. (SE)	Est. (SE)	Est. (SE)
(Intercept)		2.2 (0.16)	2.23 (0.08)	1.73 (0.13)	2.05 (0.19)
Country	UK	0.15 (0.20)	-0.07 (0.16)	-0.16 (0.18)	-0.37 (0.18)
	EU	1.16 (0.30)	0.76 (0.23)	0.61 (0.27)	-0.47 (0.26)*
	Australasia	0.41 (0.20)	0.21 (0.16)	-0.13 (0.18)	0.54 (0.18)
	L. America	0.02 (0.3)	0.11 (0.26)	-0.14 (0.30)	0.29 (0.30)
	Other	0.84 (0.29)	0.09 (0.23)	0.05 (0.26)	-0.15 (0.25)
Knowledge	>median	-0.17 (0.15)	-0.03 (0.11)	-0.16 (0.14)	0.20 (0.13)
Experience	>median	0.18 (0.16)	0.01 (0.11)	0.13 (0.14)	-0.05 (0.14)
Gender	Female	0.01 (0.15)	-0.07 (0.11)	-0.03 (0.13)	-0.04 (0.13)
No. genera	>median	0.13 (0.15)	-0.03 (0.11)	-0.09 (0.14)	0.25 (0.15)*
Grow <i>Phragmipedium</i> ?	Yes	NA	-0.13 (0.11)	-0.18 (0.15)	0.21 (0.14)
Professional	Yes	0.08 (0.25)	0.05 (0.18)	0.37 (0.23)	0.44 (0.22)
Grow <i>Paphiopedilum</i> ?	Yes	0.03 (0.10)	-0.12 (0.12)	-0.13 (0.15)	-0.06 (0.16)
Hobbyist	Yes	-0.00 (0.09)	-0.03 (0.23)	0.30 (0.26)	-0.10 (0.26)
Age	>median	0.20 (0.14)	-0.05 (0.11)	-0.12 (0.12)	-0.13 (0.12)

Shading denotes significance, all at $P 0.05$ except those marked *, which are significant at $0.05 \leq P \leq 0.1$ NA = not included in top models.

Reference levels: U.S.; < median knowledge; no experience; male; < median genera; no *Phragmipedium*; nonprofessional; no *Paphiopedilum*; nonhobbyist; < median age (see Supporting Information for relative variable importance and confidence intervals).

“Good” or “Adequate”), and 14.0% ($n = 19$) expressed support of CITES aims but negative views of its current application. Negative statements were generally detailed, allowing them to be split into themes, the most frequent being “CITES hampers orchid conservation” (26.7% of negative statements), e.g., “Orchids could be rescued when their habitat is cut down but CITES won’t allow this.” Others included “Too strict” (22.2%), “Too complicated” (21.4%), and “Not enforced uniformly” (18.9%). In

addition, 9.3% ($n = 37$) of negative statements alluded to the ease of noncompliance, e.g., “Stupid, counter-productive and generally ignored or got around.”

Discussion

This study represents the first in-depth investigation into CITES noncompliance among a specific international wildlife trading community, using a case-study of

horticultural plants, illegal trade of which is widespread but largely ignored (Phelps & Webb 2015). Understanding noncompliance with conservation rules is a priority (Solomon *et al.* 2015), providing information that can inform policy and assist in encouraging compliance (St John *et al.* 2011).

Utility of the UCT

The UCT has found increasing conservation application (e.g., Nuno *et al.* 2013), out-performing DQs and specialized methods (e.g., randomized response technique) when used face-to-face (Glynn 2013). Our UCT estimates were not significantly higher than DQ, even at broadened confidence levels, possibly because self-complete online surveys offer greater anonymity than face-to-face administration (Holbrook & Krosnick 2010). In addition, widespread negative opinions of CITES in our sample may have reduced social desirability pressures to conceal rule-breaking. This highlights the need to better understand and consider the limitations of specialized questioning techniques, and recognize the utility of direct questioning when designing surveys. We call for further research into the limitations of these techniques, how their use affects findings, and contexts in which they are most appropriate.

Enforcement priorities

Strengthening CITES enforcement is a priority (Phelps *et al.* 2009), supported by little concern about the possibility of punishment for CITES noncompliance among our respondents. Rule-breaking in our sample was not widespread but focused on subgroups breaking several rules, supporting the recognized need for a targeted approach to enforcement (Res. Conf. 11.3 [Rev.CoP16]). We suggest that one priority for enforcement improvements should be online wildlife trade, which is growing and hard to control (Lavorgna 2014). The prevalence of noncompliant online purchases by professional growers in our sample is of particular concern as this group is likely to buy in higher volumes. As online orchid buyers have a preference for rarity (Hinsley *et al.* 2015) and threatened wild plants are sold widely online (Shirey *et al.* 2013), our results demonstrate that the internet may be allowing traders to bypass CITES rules for rare species. In particular, enforcement efforts should focus on improving the detection of protected species at the point of sale on various platforms (Sajeva *et al.* 2013), and on intercepting orchids transported via the postal system, only one seizure of which has been reported to date (TRAFFIC 2014).

The role of consumer countries in preventing illegal trade has been recognized by CITES (Res. Conf. 11.3 [Rev. CoP16]), and our findings suggest that a second priority should be to identify enforcement gaps at the point of import. In particular, we found that noncompliance among EU respondents (excluding the UK) was significantly more likely, supporting findings that the EU is a destination for smuggled wildlife (Auliya *et al.* 2016), potentially due to variable enforcement between Member States (Reeve 2006). Specific weak points of entry to the EU for orchids and for other CITES taxa should be identified, and the best ways to address these enforcement gaps assessed.

Engaging traders and end-consumers in policy decisions

While increased enforcement should be a priority, many countries do not have the capacity to adequately enforce wildlife trade legislation (Phelps *et al.* 2009) and we note that enforcement alone may not automatically reduce illegal trade (Challender & MacMillan 2014). Reluctance of Australasian respondents in our study to admit to smuggling via DQ could be linked to the region's strict enforcement of wildlife trade rules (e.g., Commonwealth of Australia 2015). Although potentially a chance result, it may suggest that stricter enforcement increases secrecy about noncompliance, rather than preventing it from occurring completely. We therefore recommend that enforcement improvements are complemented with efforts to address the widespread disengagement and distrust of CITES among orchid growers. While greater knowledge of rules has been linked with higher compliance at a community level (Nkonya *et al.* 2008), we found that better knowledge of CITES rules was linked to more active forms of noncompliance, suggesting that simply raising awareness of the rules is unlikely to be effective. We suggest that noncompliance may be linked to widespread negative opinions of CITES. For example, those stating that CITES is bad for conservation may be using "neutralization," a process by which rule-breaking can be justified as being for the greater good (Sykes & Matza 1957). Similarly, small-scale rule-breaking can be used as a form of protest by those who feel powerless to change laws they disagree with (Scott 2008), a practice demonstrated in the case of wildlife poaching (Bell *et al.* 2007). If these processes are playing a role in rule-breaking, one potential solution may be for those most affected by CITES to be empowered by being more involved in decisions relating to its rules. This could be achieved by better engagement with horticultural networks and traders' associations.

While negative opinions may make them initially unwilling, encouraging the involvement of key stakeholders

in these discussions may increase compliance and trust, strengthen legal businesses, and allow the reasons for noncompliance to be better understood. For example, we found that professionals were more likely than nonprofessionals to launder, possibly to bypass high charges such as those of £74 per plant genus for UK imports, (UK Government 2013), even for orchids that have over 800 genera. As professionals were also more likely to own wild plants, this laundering could represent illegal movement of wild orchids as artificially propagated plants but is also likely to include plants of all sources transported under the wrong names. This may be undermining the important role that CITES plays in monitoring species in trade, and efforts should be made to understand how these charges may impact small businesses, and how this may affect traders' compliance behavior.

As it was self-selecting and administered online, our sample may have omitted countries without well-established orchid networks and internet access, suggesting that further studies of consumer behavior and compliance would be of benefit. Our recommendations for improving compliance are likely to apply to the trade in other wildlife products, particularly those with both legal and illegal trades, and those with subgroups of specialist consumers. In addition, our findings highlight that knowledge of the behavior and motivations of consumers and traders in any wildlife market can provide information about the effectiveness of current approaches, and inform recommendations to strengthen compliance.

Acknowledgments

AH was funded by NERC (NE/J500458/1) and AN was supported by Defra Darwin Initiative. Translation checks provided by H Shimai, O. Poh-Tek, N. Zakaria, P. Etique, D. Bogarín, and I. Simon. Policy advice from K. Malsch.

References

- Aronow, P.M., Coppock, A. & Crawford, F.W. (2015). Combining list experiment and direct question estimates of sensitive behavior prevalence. *J. Surv. Stat. Methodol.*, **3**, 43-66.
- Auliya, M., Altherr, S., Ariano-Sanchez, D. *et al.* (2016). Trade in live reptiles, its impact on wild populations, and the role of the European market. *Biol. Conserv.* <http://dx.doi.org/10.1016/j.biocon.2016.05.017>. August 27 2016.
- Barton, K. (2015). R package: MuMIn: multi-model inference. v. 1.15.1.
- Bell, S., Hampshire, K. & Topalidou, S. (2007). The political culture of poaching: a case study from northern Greece. *Biodivers. Conserv.*, **16**(2), 399-418.
- Blair, G. & Imai, K. (2010). R package: statistical methods for the item count technique and list experiment. v., **8.0**.
- Burnham, K. & Anderson, D. (2002). *Model selection and multimodel inference: a practical information-theoretic approach*. Springer-Verlag, New York.
- Challender, D.W.S. & MacMillan, D.C. (2014). Poaching is more than an Enforcement Problem. *Conserv. Lett.*, **7**(5), 484-494.
- CITES. (2004). Orchid hybrids exempted from CITES. pp. 1-10. <http://www.cites.org/common/cop/13/E13-P41Annex.pdf> (visited May 18, 2015).
- CITES. (2013). The CITES species. <https://www.cites.org/eng/disc/species.php> (visited Jul. 22, 2015).
- Commonwealth of Australia. (2015). *How the convention on international trade in endangered species of wild fauna and flora works—wildlife trade and conservation in Australia*. Australian Government. Department of Environment. <http://www.environment.gov.au/biodiversity/wildlife-trade/cites/how-cites-works> (visited Sept. 12, 2015).
- Doukakis, P. Pikitch, E.K., Rothschild, A., DeSalle, R., Amato, G. & Kolokotronis, S.O. (2012). Testing the effectiveness of an international conservation agreement: marketplace forensics and CITES caviar trade regulation. *PLoS One*, **7**(7), e40907.
- Droitcour, J. Caspar, R.A., Hubbard, M.L., Parsley, T.L., Visscher, W. & Ezzati, T.M. (1991). The item count technique as a method of indirect questioning: a review of its development and a case study application. In P.P. Biemer *et al.*, editors. *Measurement errors in surveys. Wiley series in probability and statistics*. John Wiley & Sons, Inc, Hoboken, NJ, USA.
- Glynn, A.N. (2013). What can we learn with statistical truth serum? Design and analysis of the list experiment. *Public Opin. Quart.*, **77**(S1), 159-172.
- Haken, J. (2011). *Transnational crime in the developing world, global financial integrity*. Washington, D.C.
- Harrison, M., Baker, J., Twinamatsiko, M. & Milner-Gulland, E.J. (2015). Profiling unauthorized natural resource users for better targeting of conservation interventions. *Conserv. Biol.*, **29**(6), pp. 1636-1646.
- Hinsley, A., Verissimo, D. & Roberts, D.L. (2015). Heterogeneity in consumer preferences for orchids in international trade and the potential for the use of market research methods to study demand for wildlife. *Biol. Conserv.*, **190**, 80-85.
- Holbrook, A.L. & Krosnick, J.A. (2010). Social desirability bias in voter turnout reports: tests using the item count technique. *Public Opin. Quart.*, **74**(1), 37-67.
- IUCN. (2015). Conservation successes overshadowed by more species declines—IUCN Red List update. <http://www.iucn.org/?21561/Conservation-successes-over-shadowed-by-more-species-declines-IUCN-Red-List-update> (visited Jul. 24, 2015).
- Jepson, P. & Ladle, R.J. 2009. Governing bird-keeping in Java and Bali: evidence from a household survey. *Oryx*, **43**(03), 364-374.

- Kahler, J.S. & Gore, M.L. (2012). Beyond the cooking pot and pocket book: factors influencing noncompliance with wildlife poaching rules. *Int. J. Comp. Appl. Crim. Justice*, **36**(2), 103-120.
- Lavorgna, A. (2014). Wildlife trafficking in the Internet age. *Crime Sci.*, **3**(1), 5-17.
- Nkonya, E., Pender, J. & Kato, E. (2008). Who knows, who cares? The determinants of enactment, awareness, and compliance with community Natural Resource Management regulations in Uganda. *Environ. Dev. Econ.*, **13**(1), 79-101.
- Nuno, A.N., Bunnefeld, N., Naiman, L.C. & Milner-Gulland, E.J., (2013). A novel approach to assessing the prevalence and drivers of illegal bushmeat hunting in the Serengeti. *Conserv. Biol.*, **27**(6), pp.1355-1365.
- Nuno, A. & St John, F.A.V. (2015). How to ask sensitive questions in conservation: a review of specialized questioning techniques. *Biol. Conserv.*, **189**, 5-15.
- Phelps, J. & Webb, E.L. (2015). "Invisible" wildlife trades: Southeast Asia's undocumented illegal trade in wild ornamental plants. *Biol. Conserv.*, **186**, 296-305.
- Phelps, J., Webb, E.L., Bickford, D., Nijman, V. & Sodhi, N.S. (2010). Boosting cites. *Science*, **330**(6012), 1752-1753.
- R Core Team (2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>.
- Reeve, R. (2006). Wildlife trade, sanctions and compliance: lessons from the CITES regime. *Int. Aff.*, **82**(5), 881-897.
- Sajeva, M., Augugliaro, C., Smith, M.J. & Oddo, E. (2013). Regulating Internet trade in CITES species. *Conserv. Biol.*, **27**(2), 429-430.
- Scott, J.C. (2008). *Weapons of the weak: everyday forms of peasant resistance*. Yale University Press, New Haven.
- Shirey, P.D. Kunycky, B.N., Chaloner, D.T., Brueseke, M.A. & Lamberti, G.A. (2013). Commercial trade of federally listed threatened and endangered plants in the United States. *Conserv. Lett.*, **6**(5), 300-316.
- Solomon, J.N., Gavin, M.C. & Gore, M.L. (2015). Detecting and understanding non-compliance with conservation rules. *Biol. Conserv.*, **189**, 1-4.
- South, N. & Wyatt, T. (2011). Comparing illicit trades in wildlife and drugs: an exploratory study. *Deviant Behav.*, **32**(6), 538-561.
- St John, F.A.V., Keane, A.M., Edwards-Jones, G., Jones, L., Yarnell, R.W. & Jones, J.P. (2011). Identifying indicators of illegal behaviour: carnivore killing in human-managed landscapes. *Proc. Roy. Soc. B*, p.rspb20111228.
- Sykes, G.M. & Matza, D. (1957). Techniques of neutralization: a theory of delinquency. *Am. Sociol. Rev.*, **22**, 664-670.
- Thomas, B. (2006). Slippers, thieves and smugglers—dealing with the illegal international trade on orchids. *Environ. Law Rev.*, **8**, 85-92.
- TRAFFIC. (2014). TRAFFIC bulletin seizures and prosecutions. Vol. 16 No. 3 (March 1997) to Vol. 26 No. 2 (October 2014). (visited August. 17, 2016).
- UK Government. (2013). *Fees for CITES applications for plants*. Animal Health and Veterinary Laboratories Agency, (June), 1-5. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/355265/cites-ag-ct-02.pdf (visited Sept. 17, 2015).
- USDA. (2015). *Floriculture crops 2014 summary*. United States Department of Agriculture, National Agricultural Statistics Service, Washington, D.C. <http://usda.mannlib.cornell.edu/usda/nass/FlorCrop//2010s/2015/FlorCrop-06-04-2015.pdf> accessed Sept 17 2015.
- Wyatt, T. (2009) Exploring the organization of Russia Far East's illegal wildlife trade: two case studies of the illegal fur and illegal falcon trades. *Global Crime*, **10**(1-2), 144-154.