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Network analysis of a stakeholder community combatting illegal wildlife trade

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Article Impact Statement: Communication among those combatting illegal wildlife trade is confounded by stakeholder variables (ethics, confidentiality), competition, and fundraising.

Abstract: The illegal wildlife trade has emerged as a growing and urgent environmental issue. Stakeholders involved in the efforts to curb wildlife trafficking include non-governmental organizations (NGOs), academia, and state government/enforcement bodies. The extent to which these stakeholders work and communicate amongst each other is fundamental to effectively combatting illicit trade. Using the United Kingdom as a case study, we conducted a mixed methods study using a social network analysis and stakeholder interviews to assess communication relationships in the counter wildlife trafficking community. NGOs consistently occupied 4 of the 5 most central positions in the generated networks, while academic institutions were routinely the converse, filling 4 of the 5 most peripheral positions. However, NGOs were also shown to be the least diverse in their communication practices, compared to the other stakeholder groups. Through semi-structured interviews, personal relationships were identified as the biggest key to functioning communication. Participant insights also showed that stakeholder-specific

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variables (e.g. ethical/confidentiality concerns), and competition and fundraising, can have a confounding effect on inter-communication. Evaluating communication networks and intra-stakeholder communication trends is essential to facilitate a more cohesive, productive, and efficient response to the challenges of combatting illegal wildlife trade.

Introduction

As one of the 4 largest illicit trades along with drugs, weapons, and human trafficking, the illegal wildlife trade is worth upwards of US\$20 billion (Kurland & Pires 2016). The trade is highly varied, including both animals and plants; their live and derivative forms used in many sectors (Schneider 2008; Illes 2016). The illegal trade in wildlife undermines sustainable trade, as outlined under the Convention on the International Trade in Endangered Species (CITES) (CITES 2017); the overarching inter-governmental institution responsible for regulating wildlife trade for its 183 member parties (CITES 2017).

Perpetrators of illegal wildlife trade operate internationally, across varying socioeconomic levels and demographic groups; and there are often links to organized crime within the most lucrative trafficking circuits (Wyatt 2009; Haas & Ferreira 2015; Illes 2016). These linkages manifest themselves as sophisticated communications and operations networks (Wyatt 2009; Haas & Ferreira 2015). Enforcement activities to disrupt trafficking rings include the aim to identify and remove key persons, whose absence causes the most disruption among the web of operators in the illegal supply chain (Haas & Ferreira 2015). This pointed approach invokes social network analysis techniques. Social network analysis examines linkages and attributes between actors known as “nodes,” and is becoming recognized as a useful tool in conservation (Borgatti et al. 2013; Mbaru & Barnes 2017; Groce et al. 2018).

Output diagrams display complex relationships in ways that can help identify critical relationships in a network, such as nodes that are the most central to its success, and clusters among similar actors (Haas & Ferreira 2015; Hinsley et al. 2016).

Observing the ties (linkages) that represent relationships between actors, social network analysis can help conservation enforcers glean knowledge of influential links, systemic bottlenecks, insulated subgroups, and much more (Cross et al. 2001; Prell et al. 2009).

However, enforcement bodies are not the only institutions involved in shaping the response to wildlife trafficking. In addition to action from the enforcement sector, stakeholders from other state departments, NGOs, academic communities, and others have also responded to the threat posed by illegal trade (Baker 1999; Nurse 2013; Hinsley et al. 2016). Enforcement technique, strategy, execution, etc. can be informed and influenced (both positively and negatively) by government, NGOs, and academic findings (Baker 1999; Parr 2011). Like the networks they are trying to disrupt, the counter wildlife trafficking (CWT) community is formed of many individuals and institutions, some more influential than others, who can affect the success of enforcement and mitigation of illegal trade. As Fahlman (2015) put it, “It takes a network to defeat a network.”

While party to CITES, the United Kingdom (UK) is both a known transport hub and demand nation for trafficked wildlife, in addition to having an infrastructure of NGOs, academics and government/enforcement institutions that address illegal wildlife trade (Illes 2016; Utermohlen & Baine 2017). Enforcement initiatives such as “Operation Charm,” a cooperative effort between London’s Metropolitan Police and Non-Governmental Organizations (NGOs), have been responsible for substantial CWT enforcement successes

and confiscations (Stewart 2000; UK Environmental Law Association 2016). Illegal wildlife trade caught the attention of the British royal family, and has received increasing political attention in recent years through programs like the Illegal Wildlife Trade Challenge Fund—which allocates £14 million to projects around the world (DEFRA 2017; The Royal Foundation 2017). The relatively high profile of wildlife trafficking in the United Kingdom, as well as its hosting headquarters or site offices for 72 institutions whose work involves studying and tackling the illicit trade makes the country an excellent model for social network analysis.

Understanding the sophisticated web of collaborations and communications in many trafficking operations, it begs the question as to what the communication network between conservation actors looks like. Does the CWT community work together productively? Effective intra-stakeholder dialogue is important in fostering greater coordination and innovation, while reducing bottlenecks in communication and replication of efforts (Kraut & Streeter 1995; Crane & Livesey 2003). Considering that many trafficking networks are designed for efficiency, often at the expense of security (Haas & Ferreira 2015), what do the various CWT stakeholders value and demonstrate during their communications with each other? Using the United Kingdom as a case study, here we apply social network analysis to (a) establish communication relationships between stakeholder groups combatting illegal wildlife trade; (b) illuminate patterns between them; and (c) highlight themes to intra-stakeholder dialogue.

Methods

This research was approved by the Research and Ethics Committee of the [blinded], and conducted between May and August 2017. The study used two methodological approaches, social network analysis and semi-structured interviews with stakeholders. We employed an advanced search on Google.com with the terms “illegal wildlife trade” and sites or domains ending in “.co.uk” to restrict results to organizations within the United Kingdom (UK), and “.ac.uk” to identify universities in the UK with academics who worked on wildlife trafficking. Snowball sampling from both participant recommendation and website content, suggesting institutions and key individuals, also identified additional stakeholders (Newing et al. 2011). We ultimately compiled a list of 72 institutions, including NGOs, government and enforcement agencies, and universities. We engaged these stakeholder groups with the understanding that illegal wildlife trade involves many other actors, including trading associations, online sites, donors, and the transport and financial sectors.

Questionnaires

We developed a questionnaire using the software Qualtrics, Version 6-8.2017 (Supporting Information, S1). The questionnaire contained primarily closed-ended multiple choice questions, with one open-ended question regarding the participant’s job title. The 3 primary blocks consisted of matrices pairing organizations against frequency, to ascertain how often the respondent communicated with the listed institution. If they clicked on any frequency other than “Never,” they were presented with a follow-up question regarding which party instigates communication more frequently between the 2 of them. Another question asked respondents to rank their most-frequently used methods of communication from a list of choices. Finally, using a Likert scale, participants were asked to gauge general

perception of the level of challenge associated with communicating with other stakeholder groups.

Using the anonymous link function copied into individual emails, we distributed the questionnaire to the 72 institutions identified via the advanced Google search and snowball sampling. In order to be a candidate for receiving a questionnaire, NGOs had to have either a physical address or a phone number in the UK. We chose to limit government and enforcement agencies to only those overarching and key divisions, unless they were mentioned frequently as a snowball referral. For example, the UK has 82 individual police forces, the majority of which were excluded due to level of relevance to and bandwidth of the project's scope (United Kingdom Home Office 2013). The selection criteria resulted in 41 NGOs, 19 universities, and 12 government/law enforcement organizations. We sent candidates, one person per an organization, an initial email requesting their participation. If resources or referrals for the organizations identified a staff member who worked on trade issues, then that individual was targeted for the survey. Otherwise the email requested that the survey be answered by whoever they deemed as most pertinent to the subject. Initial survey requests were followed up by another request approximately 3 to 4 weeks later; and another 2 weeks after that if necessary. For organizations that listed a phone number, we augmented their follow up email with a phone call if they had not replied. Depending on the contacts we were able to acquire, we sent survey request emails out through general "contact us" forms and email addresses listed on organizations' websites, as well as personal email addresses. Survey participants were made aware that, while their names would remain anonymous, the name of their organization would be mapped in a network analysis intended for publication.

Statistical & Network Analysis

Questionnaire responses were imported from Qualtrics into Microsoft Excel for cleaning and basic statistical analysis, then into UCINET 6 (Borgatti et al. 2002) for network analysis.

We separated the data on who respondents communicated with into 2 networks to analyze; a 72x72 matrix which included non-respondent organizations, allowing us to examine general trends in the network at large, and a 43x43 matrix which excluded non-respondent organizations, enabling specific statistical inquiry with higher confidence. Working first with the 72x72 matrix to look at the wider community, we used a Freeman degree centrality calculation to count the number of links held by each actor, or node, and to check for isolates (i.e. completely disconnected nodes) (Borgatti et al. 2013). A paired t-test determined the significance of the centrality of respondents' organizations versus non-respondents' organizations. To examine whether the types of stakeholder groups differed in their centrality, we created attribute files for each combination and conducted a t-test against degree centrality for significance.

Separately on the 43x43 matrix, which was the dataset of respondents only, we performed the same Freeman degree centrality analysis. Through use of the External-Internal (E-I) index, which determines the diversity of ties between nodes, we questioned the presence of homophily among stakeholders. The concept of homophily suggests that similar actors are drawn to each other, and have a natural ease of communications (McPherson et al. 2001; Prell et al. 2009). Paired t-tests reviewed significance by comparing 2 stakeholder groups against their E-I index values. We then conducted a paired t-test to determine significance of centrality against 2 attributes: 1) respondents who ranked email as their most frequently-

used method of communication, and 2) stakeholders whose respondent said that 50% or more of the organization's staff was comprised of people working specifically on illegal wildlife trade. We compared these attributes against centrality because, respectively, the theme of email usage was often raised during stakeholder interviews, and we wanted to assess if/how the size and focus of organizations influenced placement in the network.

For the final 3 questions that asked respondents to rank NGOs, enforcement organizations and academics/academic institutions from 1 to 5, based on how challenging they found communicating with them, we analyzed the data in IBM, SPSS Statistics, Version 24 (IBM Corp. 2016). We used a Kruskal-Wallis test, followed by post hoc Dunn's (1964) pairwise comparisons with a Bonferroni correction to compare.

Interviews

In total, semi-structured interviews were conducted with 11 individuals highlighted during our systematic survey process; 4 from NGOs, 4 academics, and 3 from government advisory bodies or enforcement agencies—an effort to have as equal representation of ideas from stakeholders in each group as possible. Of the interviewees, all were solicited to complete the survey; two did not. The interviews took place in person or via skype and, due to the time frame and scope of the project, were meant to supplement survey results with added human dimension, not reflect an ideal sample size. Interviews typically lasted 45 minutes to one hour and consisted of 15 questions (Appendix S2) based on literature review and the authors' own experiences navigating the CWT community. Content of the questions was to determine who these specialists communicate with regarding illegal wildlife trade, and what kind of barriers exist to communications with their counterparts. We then performed a

thematic coding analysis, using QSR International's NVivo Pro 11 software, to identify idea patterns across the dataset (QSR International Pty Ltd. 2015).

Results

Statistical & Network Analysis

Of the 72 institutions to which the questionnaire was distributed, 43 (59.7%) gave responses. From the contacted organizations, 46.3% (n 19) of NGOs, 89.5% (n=17) of academic institutions, and 58.3% (n=7) of government/enforcement organizations returned questionnaires. While social network analyses are vulnerable to low response rates, rates of 60-70% are regarded as producing robust data, with <0.01 network measurement error (Kossinets 2006; Wang et al. 2012; Cronin 2016). A chi-square contingency table showed a significant association between number of responses and stakeholder group ($\chi^2(2)=10.053$, $p<0.010$); academics had a high rate of response, NGOs were poor, and government/enforcement organizations responded at expected levels.

Analysis of the 72x72 stakeholder network (Fig. 2) revealed that there were no isolates, and the network was generally well-connected. The centrality between the organizations of respondents and non-respondents was not significantly different ($t(28)=-1.255$, $p=0.394$). This factor, along with question designs that reminded respondents to consider outgoing *and* incoming communications, ensured that non-respondent organizations could be included to describe the network at large. In-degree centrality scores analyzing who sat in the middle of the network based on the number of ties directed toward the node, ranged from 2 to 87 (mean of 28). Four of the top 5 most central stakeholders were NGOs, and 4 of the 5 institutions that displayed the least In-degree centrality were academic institutions

(Table 2). While there is no significant difference ($t(11)=-1.937, p=0.337$), between the centrality of NGOs and government/enforcement organizations within the network, NGOs are more central than academic institutions ($t(40)=14.244, p=0.001$). Alternatively, academic institutions have a statistically higher In-degree centrality than government/enforcement bodies ($t(11)=-11.950, p=0.004$).

The 43x43 stakeholder network also did not have any isolates, and centrality scores ranged from 2 to 87 (mean of 27). Three of the top 5 most central stakeholders were NGOs; the remaining 2 being government/enforcement organizations (Table 2). Of the stakeholders least central within the network, 4 were academic institutions and one was an NGO (Table 2). There was a significant difference ($p<0.001$) between the E-I index values of NGOs and academic institutions; suggesting academics have more diverse connections than the former ($t(16)=2.693$). Government/enforcement organizations also had more diverse connections than NGOs ($t(6)=-1.692, p=0.005$), however we found no significant difference between the index values of government/enforcement and academic respondents ($t(6)=0.307, p=0.680$). Analyses also indicated that stakeholders who ranked email as their most frequently-utilized medium to communicate about wildlife trafficking occupied more central positions in the network ($t(31)=13.483, p=0.007$). Results suggest that stakeholder organizations that have 50% or more of the staff involved with work on the challenge display greater In-degree centrality ($t(3)=-11.112, p=0.036$).

A Kruskal-Wallis test revealed there were significant differences between the distributions of how challenging respondents found distinct groups to communicate with ($H(2)=8.661, p=0.013$). The post hoc analysis revealed a statistically significant difference in median

rankings between academics (52.10) and enforcement organizations (72.55) ($p=0.022$), but not between any other group combination. Respondents found academics/academic institutions significantly easier to communicate with than enforcement organizations (Fig 1).

Interviews

Eight of 11 interviewees (72.7%) identified intra-stakeholder CWT communications as below adequate. Common themes emerged from interviews with individuals of each stakeholder group, which were punctuated by thought-provoking outliers.

Motivations and Goals. Overwhelmingly, participants cited personal relationships as the primary driving force behind productive communications in the CWT community. When asked if they felt that their goals relating to illegal trade differed with those of their counterparts, the majority of participants thought that everyone had similar overarching goals (e.g. protecting the interests of wildlife), but differing approaches and competing demands sometimes hindered collaboration. Five of the 11 participants clearly referenced that they felt they communicated with a diverse set of stakeholders, in both occupation and ethos, and that their agenda and practices around illegal wildlife trade were influenced by their counterparts.

Stakeholder Specific. Some themes in communications were uniquely observed in the context of stakeholder group. For instance, with one exception from an NGO, ethical and confidentiality concerns were cited exclusively by participants from academia and government/enforcement bodies as a specific challenge that can hamper communications

and frustrate involved parties. Additionally, one enforcement participant mentioned many instances where their bounds of confidentiality caused other stakeholders to chafe when interfacing with them. They followed this up by asserting the importance of personal relationships in counteracting those types of frustrating situations. Respondent 4 contended that the interest and number of trained individuals among UK police forces on CITES matters is regrettably low, especially as personnel changes in forces affect consistency, making the establishment of contacts in the enforcement sphere difficult. The political influence held by government/enforcement organizations make them a desirable contact to have, but, as Respondent 8 also lamented,

“If you have turnover of staff you can’t learn about the fourth biggest trade in the world and how to tackle it in six months. It’s just impossible.”

Two academic interviewees commented how they thought the new policy on open access research in the UK would help make their findings more accessible to CWT practitioners (Research Councils UK 2017). Additionally, participants raised the matter of competition and fundraising as a challenge that can arise when trying to interface with NGOs, or a certain “jealousy” with information (Participant 11).

Overarching Barriers. Several participants, spanning all the stakeholder groups, mentioned ego and organizational politics as elements that impede communication around illegal wildlife trade. Participant 5 made the point that these elements, combined with the inherently small number of CWT stakeholders, also put the community at risk of becoming an “incestuous” network. They gave an example from their recent experience liaising with CWT actors in the United States,

“When they work together and want advice about a particular country or a particular program or a particular species they all go to the same people. Which means that particular stories circulate all the time. And then you try and backtrack to where did that story come from, and it’ll be a particular individual who is well known in the wider networks and whenever they want to know anything about topic ‘X,’ they go to that person. And they just take that person’s view as the truth.”

Unexpectedly, over half of the participants felt strongly that there is a glut of emails in the sphere of communications, to its detriment. While all acknowledged that face-to-face encounters were most productive for communications, they recognized it as a practical impossibility. However, at least 2 participants felt that more meaningful communicating would be accomplished if people “just picked up the phone” (Participant 1), as opposed to spending the day clearing their inbox. Participant 8 went as far to say that,

“...everyone in conservation should go on a management training course,”

as they felt that stakeholders often abuse and overextend the use of email. In addition to those impediments to communications, other notions about what participants want to see improved also emerged. For instance, there was a trend of participants intimating the increasing need and desire to communicate with high-level decision makers; whether it be internal to the network at NGOs, in politics to influence priorities, or banks and businesses to change policy.

There was one participant who was isolated in their notions of what would yield for better results in CWT stakeholder communications. Participant 10 advocated that communication networks could be diversified by challenging the prevailing narrative around illegal wildlife

trade. They wanted to encourage more debate within the community, especially around the idea of sustainable trade. They also felt that academics should be more outspoken stakeholders in terms of entering and engaging the public arena on the issue. Despite the diversity added by this participant's views, the theme of scheduled, collaborative meeting groups was consistently mentioned for ease and interfacing as a way that stakeholders did much of their effective communicating. Two interview participants indicated the NGO, Wildlife and Countryside Link in particular when referring to a venue for these meet ups. It was also specified 3 times in the section at the end of the survey that requested respondents cite unlisted pertinent organizations. Wildlife and Countryside Link is a coalition organization for members to collaborate over green issues (Wildlife and Countryside LINK 2017).

Discussion

When questioned if they thought that the communication between CWT stakeholders is adequate, 8 of 11 interviewees indicated "No." Examining this prevailing response against results from the network analysis, our study focused on the intersection of how and with whom CWT stakeholders communicate, to understand why this sentiment is a trend and reflect on opportunities for improvement. Our results concluded that, not only did we find a higher level of responsiveness between the different stakeholder groups solicited for responses, but the respondents themselves also found certain groups easier to communicate with as well. Moreover, the significant disparity between different stakeholders' centrality paired against levels of homophily indicates that the pattern of communications in this network requires balancing, and is a useful model that can be

transferred and applied to other country-level or international communities combatting illegal wildlife trade.

Questionnaire respondents found academics/academic institutions easier to communicate with than enforcement organizations (see Fig. 1). Indeed, they were proportionately the most responsive to our survey requests. However, despite academic institutions occupying more central positions in the network at large (72x72) than government/enforcement bodies, 4 of the 5 organizations ranked least central in both networks were academic stakeholders. They also did not have a significantly more diverse contact network than government/enforcement organizations from the group of respondents. The effects of downsizing resources, bureaucracy, shifting priorities, and staff turnover in politics and police forces all put strain on the accessibility and helpfulness of stakeholders in government/enforcement positions (Cordella & Tempini 2015; Illes 2016). So why are academics, if they are easier to communicate with and more responsive as well as relatively more diverse in who they speak with, consistently showing as some of the least connected stakeholders in the network?

Other than several academic respondents mentioning that they observe strict ethical anonymity if any of their research participants could be compromised, they are arguably under fewer constraints by how and with whom they can communicate compared to stakeholders like those in government/enforcement. However, despite the rise in open access, albeit its contested merits (Joseph 2013; Xia 2013), journal paywalls and academic exclusivity are often cited as reasons that continue to perpetuate the research-implementation mismatch, that especially hinders information exchange between

academics and conservation practitioners (Jarvis et al. 2015). A different set of priorities inherent to academic research and publication can also hinder applicable communication and perceived usefulness of contributions from academics. The “publish or perish” phenomenon pervasive to success in academia often results in science that practitioners like NGOs or enforcers do not find applicable to their efforts (Kampourakis 2016). Meanwhile, universal stereotypes of academics being out of touch with conservation realities, can lead to avoidance by other stakeholders. This notion, while noted in literature, was also echoed by an enforcement stakeholder interviewed (Sonnert & Holton 2002). These alienating factors put academic institutions at risk of becoming knowledge silos; where their information—often novel—can miss the opportunity to be groundbreaking for CWT because they could be better-connected to other stakeholders.

Scrutinizing stakeholders with the lowest centrality ratings in a communications network can help identify where missed opportunities to positively connect may be occurring. In the combined measures of the 2 networks, 8 of the 10 stakeholders who held the least central positions in the network were academic institutions, and the other 2 were relatively small NGOs (See Table 2). Sitting at the periphery of the network, these actors are equally as important as their more-central counterparts, because they potentially represent underutilized expertise and underemployed resources for the community as a whole (Cross et al. 2001). Likewise, the tendency for academic stakeholders to sit at the network’s periphery also offers an opportunity for other stakeholder groups. In both network models generated, NGOs held prominently central roles. Ironically, however, they had less diverse connections than both academic institutions and government/enforcement organizations, communicating mostly with other NGOs. Understanding stakeholder dynamics like

homophily against centrality reminds CWT communities to be mindful of diversifying their set of contacts and potential influencers for a greater chance of avoiding an “incestuous” network. If centrally important stakeholders do not communicate with a diverse array of organizations/institutions, it is reasonable to suggest that their practices, resources, and ideas around wildlife trafficking run the risk of being ‘pigeonholed’ by the behavior.

Marijnen (2017) underscores the hazard with her example of the European Commission desk worker who held the same position for several decades procuring funding and knowledge around biodiversity in the Central African region, including Virunga National Park. Having such tenure in such a central position, they essentially had a ‘thought monopoly’ over resources and information on the region, especially as there is normally staff turnover at least once in a decade (Marijnen 2017). Marijnen (2017) is clear to point out that this employee strategically refused promotions to retain their influential place in the network, where they were often consulted by various stakeholders for policy decisions on conflict areas. This communication network essentially doubles down on the single ‘thought reservoir’ this clerk represents, creating a limited sphere for new ideas that may reside in less central stakeholders within that community. Interview Participant 10’s isolated vehemence echoes this example; insisting the mix of contributors to the CWT dialogue must be broadened to challenge norms and prevent a “monologue of conversations.”

The CWT community could benefit from practices like auditing its communications network. Such organized evaluation reveals insights about barriers and inefficiencies. Participant 9

illustrates this point well when they talk about replication of work and efforts with an anecdote of a colleague who,

“...was brought into an African country to do a training and it was the third time they got that training, from a different group of people and, you know, wasted resources and everyone’s time. And so even though it’s an open community, there are still things that are happening that shouldn’t be happening.”

Indeed, Mace et al. (2000), agrees that duplicated and redundant efforts are rampant across organizations. They further assert that increased stakeholder communication and consensus on conservation agendas and requirements would garner greater attention and measures adopted by decision and policy makers (Mace et al. 2000). Examining what Marijnen (2017) dubs the “mundane,” less glamorous aspects of CWT communities’ policies and practices, like a communications audit, could have profound effects on outcomes—like identifying missed opportunities to collaborate, or stopping multiple organizations from inefficiently seizing the same opportunity.

There is often a dearth of critical literature on administrative and organizational practices in the environmental field. As such, conservationists should look to adjacent sectors for examples of how the community can self-evaluate and maximize effectiveness. The business sector, for instance, is not lacking in resources or studies on the nature of communications or human relationships, and how they affect productive outcomes (Cerotti & Clifton 1998; Crane & Livesey 2003; Baden-fuller et al. 2010). Cross et al. (2001) exemplify the crossover potential with their social network analysis examining the information flow related to knowledge creation and sharing within a petroleum company; a community—like

our group of stakeholders—with a variety of actors all working toward an overarching objective. They determined that one employee was a central communication point for both his expertise and access to other employees. Not only was overreliance on them causing a bottleneck in operations and information flow, but it became apparent that if they left the company, the remaining employees' ability to information share would be negligible. The company swiftly took strides to redistribute and diversify informational and organizational schematics. In the case of the CWT community, if the NGO TRAFFIC, who was most central to the network with an in-degree centrality score of 78 (compared to the lowest score of 2), dissolved and was no longer communicating ideas and resources across the spectrum of stakeholders, there would be a noticeable change in dynamics. Cross et al. (2001) applied social network analysis to help the corporate world “effectively leverage their collective expertise.” The resource-strapped CWT community can successfully utilize the same tools to tackle its wayward organizational mundanities—no need to reinvent the wheel when other disciplines have already spent the time and money identifying vehicles for improvement. Challenges of conducting a study of this nature will always include non-response bias and participant burden (Olsen 2011). When contacted, many organizations simply say they do not have the time or resources to participate. The level of non-response alone may be an indicator of stakeholders' ability or willingness to communicate.

Moving forward, enforcers and NGOs must enable access to themselves for relatively-more-communicative academic stakeholders, in order to cultivate more productive communications that will yield the kind of empirical and theoretical research that bolsters action “on the ground” (Buchy & Ahmed 2007). Since many stakeholders preferred periodic forums, like Wildlife and Countryside Link's, for ease of use in communicating with multiple

entities in one sitting, these situations should be used to host structured debates—a key communication action that would help pinpoint common goals, prevent duplication of efforts among stakeholders, and potentially pool assets and resources, like data (Mace et al. 2000). Finally, CWT communities would benefit from a more formalized approach with scheduled evaluation using metrics such as social network analysis to understand how communication gaps and barriers change over time, to achieve optimum success.

Increasing the knowledge base on how CWT stakeholders communicate amongst each other offers insights into how the community can maximize their relationships moving forward.

Ultimately, as Participant 10 reminds us,

“No individual makes a huge difference. It’s networks that make a difference.”

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Supporting Information

Qualtrics survey (Appendix S1) and interview questions (Appendix S2) are available online.

The authors are solely responsible for the content and functionality of these materials.

Queries (other than absence of the material) should be directed to the corresponding author.

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Tables:

Table 1: Full list description of abbreviated labels on network analysis diagram, with their corresponding centrality score (number of ties with other actors) and attribute identifier.

TRAFFIC score (87) indicated it was most central to the network, while University of Huddersfield, University of Leicester, and Froglife were all least connected in the network, with only two ties each. Shape symbols correspond to the organization type; circles are NGOs, squares are academic institutions, and triangles are government/enforcement organizations. These organizations were compiled using an advanced search on Google.com along with snowball sampling, in June 2017.

Organization	Network label	In-degree centrality
Act For Wildlife - Chester Zoo	AFW	14
African Conservation Foundation	ACF	16
Anglia Ruskin University	Anglia Ruskin	3
Animal and Plant Health Agency	APHA	31
Arcus Foundation	Arcus	12
BIG LIFE Foundation	BIG LIFE	10
BirdLife International	BirdLife	32
Born Free [Foundation]	Born Free	42
Centre for Environment, Fisheries and Aquaculture Science	CEFAS	15
Department for Environment Food & Rural Affairs	DEFRA	77
Elephant Protection Initiative	EPI	29
Environmental Investigation Agency	EIA	71
Fauna & Flora International	FFI	49
Foreign & Commonwealth Office	FCO	43
Four Paws	Four Paws	14
Froglife	Froglife	2
Greenpeace	Greenpeace	8
Humane Society International	HSI	31
International Institute for Environment and Development	IIED	27
International Fund for Animal Welfare	IFAW	54
International Otter Survival Fund	IOSF	4
International Union for the Conservation of Nature	IUCN	78
International Whaling Commission	IWC	12
Interpol	Interpol	9
Joint Nature Conservation Committee	JNCC	34
King's College London	King's	18
Kingston University, London	Kingston	3
Lancaster University	Lancaster	18
Lewa Wildlife Conservancy	Lewa	18
Manchester Metropolitan University	Manchester Metro	10
Middlesex University London	Middlesex	12
National Wildlife Crime Unit	NWCU	59
Natural England	Natural England	26
Natural Resources Wales	NRW	12
Northern Ireland Environment Agency	NIEA	12

5

Organization	Network label	In-degree centrality
Oxford Brookes University	Oxford Brookes	21
Oxford University	Oxford	51
Panthera	Panthera	19
Partnership for Action Against Wildlife Crime	PAW	39
Royal Botanic Gardens, Kew	Kew	27
Royal Society for the Prevention of Cruelty to Animals	RSPCA	33
Royal Society for the Protection of Birds	RSPB	35
Save the Rhino	Save the Rhino	32
Scottish Natural Heritage	SNH	13
Shepreth Wildlife Conservation Charity	SWCC	4
Space for Giants	Space for Giants	16
Stop Ivory	Stop Ivory	35
The David Sheldrick Wildlife Trust	DSWT	21
The Natural History Museum	NHM	18
The Royal Foundation of The Duke and Duchess of Cambridge and Prince Harry	The Royal Foundation	36
TRACE Wildlife Forensics Network	TRACE	33
TRAFFIC	TRAFFIC	87
Tusk (Tusk Trust)	Tusk	27
UNEP-WCMC	UNEP-WCMC	43
United for Wildlife	United for Wildlife	44
United Kingdom Border Force	Border Force	60
University of Cambridge	Cambridge	29
University of Huddersfield	Huddersfield	2
University of Kent	Kent	52
University of Leicester	Leicester	2
University of Northumbria	Northumbria	13
University of Portsmouth	Portsmouth	14
University of Sheffield	Sheffield	8
University of South Wales	South Wales	12
University of Stirling	Stirling	10
University of Sussex	Sussex	5
Wild Futures	Wild Futures	12
WildAid	WildAid	23
Wildlife Conservation Society	WCS	61
World Animal Protection	WAP	27
World Wildlife Fund	WWF	72
Zoological Society of London	ZSL	70

Table 2: Results for the 5 organizations most and least central to both the 72x72 and 43x43 matrix networks by centrality score, from the 72x72 and 43x43 matrix networks: 4 of the 5 most central organizations are NGOs, excluding DEFRA (government/enforcement), and 4 of

the most peripheral stakeholders are academic institutions, excluding Froglife (NGO). Academic institutions, though more central than government/enforcement bodies, $t(11)=-11.950, p=0.004$, were significantly less central within the network compared to NGOs, $t(40)=14.244, p=0.001$, though NGOs tend to be less diverse in terms of who they communicate with than the two other institutional groups.

	72x72 Network			43x43 Network		
	Rank	Stakeholder	In-degree	Rank	Stakeholder	In-degree
Most central stakeholders	1	TRAFFIC	87	1	TRAFFIC	87
	2	International Union for the Conservation of Nature (IUCN)	78	2	International Union for the Conservation of Nature (IUCN)	78
	3	Department for Environment Food & Rural Affairs (DEFRA)	77	3	Wildlife Conservation Society (WCS)	61
	4	World Wildlife Fund (WWF)	72	4	United Kingdom Border Force	60
	5	Environmental Investigation Agency (EIA)	71	5	National Wildlife Crime Unit	59
Least central stakeholders	72	University of Leicester	2	43	University of Huddersfield	2
	71	University of Huddersfield	2	42	University of Leicester	2
	70	Froglife	2	41	Anglia Ruskin University	3
	69	Kingston University, London	3	40	International Otter Survival Fund	4
	68	Anglia Ruskin University	3	39	University of Sussex	5

Figure 1: Side-by-side results from the Qualtrics questionnaire of respondents' perceived level of challenge in communicating with each stakeholder group, identifying

academics/academic institutions as significantly easier to communicate with than enforcement organizations ($p=0.022$).

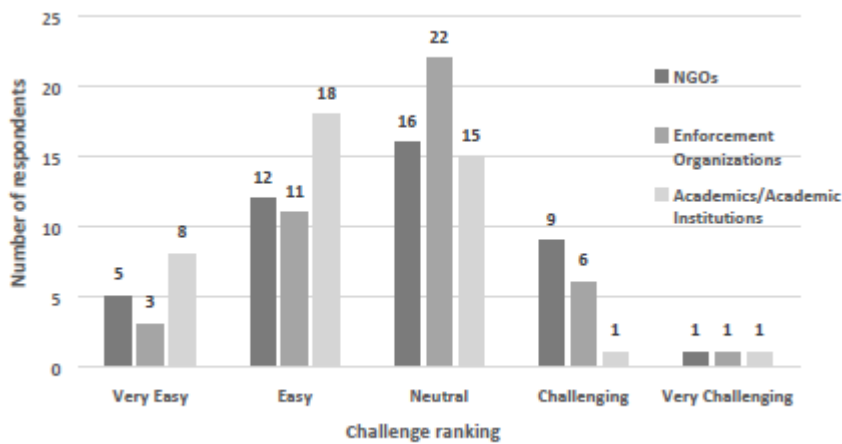


Figure 2: Social network analysis diagram from UCINET software establishing the web of communications from the 72x72 matrix, which includes both respondent and non-respondent stakeholders from the Qualtrics questionnaire. Grouped by stakeholder type, with corresponding node icons and icon size relative to the centrality within the network (larger icon=more central to the network), lines and arrows show communication linkages and directionality of communications between ties.

