Practitioner insights as a means of setting a context for conservation

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Running head: Conservation context

Keywords: conservation context; barriers, challenges; practitioner insights; principal component analysis, linear discriminant analysis

Article Impact Statement:

Understanding complex socioecological systems is critical to achieving conservation success.

ABSTRACT

A key obstacle to conservation success is the tendency of conservation professionals to tackle each challenge individually rather than collectively and in context. We sought to prioritize barriers to conservation previously described in the conservation literature. We undertook an online survey of 154 practitioners from over 70 countries to ascertain the most important barriers to conservation they faced. We used statistical analyses to identify the key impediments to conservation success and to examine whether these were affected by organizational attributes. Twenty-one barriers were identified. The importance ascribed to those was influenced by continent of operation and organization size, but not by organization age or autonomy (from larger parent organizations). We found the most important barriers to consider when undertaking conservation action were wider issues (e.g., population growth, consumerism, favoring development, and industrial-scale activity), operating environment (e.g., lack of political will, ineffective law enforcement, weak governments, corruption, safety and security), community attributes (e.g., dynamics, conflicts, and education levels), and the way conservation is undertaken (overconfidence, lack of funding, and externally set agendas). However, we advise against applying a one-size-fits-all approach. We propose that conservationists account for the complex socioecological systems they operate in if they are to achieve success.

Introduction

Despite success stories in conservation (e.g., Balmford 2012; Hoffman et al. 2015), wildlife populations have fallen by 60% since 1970 (WWF 2018). The conservation community, defined here as comprising governmental and nongovernmental (including academic) nonprofit organizations (NPOs), has been criticized for making slow and erratic progress (Salafsky et al. 2002) and failing to use evidence-based approaches (Sutherland et al. 2004). Attempts are being made to address these criticisms. Systematic reviews identify the most successful interventions (e.g., Dicks et al. 2010; Williams et al. 2012), frameworks for conservation planning (e.g., Levin et al., 2013) and adaptive management (Salafsky et al. 2002) have been developed, and attributes of effective conservation leadership have been identified (Black et al. 2011). Nonetheless, global biodiversity continues to decline (Butchart et al. 2010).

Biodiversity conservation is a wicked problem. Multiple barriers to success are linked to each other that cannot be isolated (Rittel & Webber 1973). However, the approaches, tools, and institutional structures conservationists use are generally suited to simpler, more manageable systems (Game et al. 2013). For example, frequently used logic models have been criticized for their rigid structure and incorrect assumption that change occurs in a linear, logical fashion (Stem et al. 2005).

More flexible, interdisciplinary, systems-thinking approaches, such as theory of change, can address some of these shortcomings (Black & Copsey 2014; Stebbings et al. 2016). They consider interactions of the organization and its activities with external parties, such as communities (Black et al. 2013). While these approaches are a step in the right direction, many conservationists using them struggle to account for political, social, economic, and natural events that do not seemingly intersect with their activities but can still hamper efforts. Struhsaker et al. (2005) found that effective management in African rainforest reserves is

compromised by immigration and a lack of funding for enforcement, rather than substandard performance by conservationists.

The gray and academic literatures are replete with examples of barriers to conservation , but many are considered only in isolation. We recently consolidated these into a typology of barriers (Sanders et al. 2019), which allows one to picture the context in which conservationists operate. A better understanding of this context allows conservationists and their funders to improve decision making regarding choice of intervention and deployment of limited resources. Here, we examine whether that typology, developed using feedback from face-to-face interviews with a largely Africa-based interviewee group, can be simplified to create a more parsimonious and globally relevant framework for understanding the operating context for conservation. Specifically, we ask to what extent do barriers consolidated in our typology have more universal relevance, can a more streamlined list of barriers to conservation be identified, and do organizational attributes, such as size, age, autonomy, and continent of operation influence the importance ascribed to barriers?

Methods

An online survey with 56 Likert-scale questions was developed using the barriers identified by Sanders et al. (2019). The survey was pilot tested by 3 independent NPOs and feedback assimilated before it was applied. The list of invitees was developed using nonprobability sampling (Bryman 2016) and built through comprehensive internet searches and consultation with specialists from Synchronicity Earth (www.synchronicityearth.org), a U.K.-based charity that researches grassroots and international conservation organizations and their activity. Further organizations were identified through snowball sampling (Bryman 2016). We stopped adding organizations once the sample size was 865, after which new

organizations became difficult to find. The list of resources used to identify the organizations is in Supporting Information.

Personalized invitations were sent by email to the executive director in the first instance. All email communications and procedures were approved by the Central University Research Ethics Committee at the University of Oxford. The survey was sent to 865 organizations; 797 invitations were delivered successfully. The survey was completed by 154 respondents. This large sample size helped to increase validity of the findings (Hartley 2013). The survey (Supporting Information), powered by SurveyMonkey (2015), remained live for ten weeks from November 2014 to January 2015.

Survey respondents were asked, "How much of a barrier are the following external factors to effective conservation?" We ensured that each barrier encompassed only a single issue and kept questions brief to minimize ambiguity. Respondents were asked to rate each barrier as extremely important (scored 4), relatively important (3), neither important nor unimportant (2), relatively unimportant (1), or not at all important (0). We chose rating rather than ranking because we did not want to create a closed question that would require an arbitrary choice (Schuman & Presser 1981). A 5-point Likert scale was used because this number of categories is thought to capture variability in responses adequately (Ornstein 2014).

If over 20% of respondents are unable to answer a query, it is good practice to include a do-not-know option (Ornstein 2014) because it allows distinction between a neutral position and an unknown answer. We included this because we believed most respondents would have opinions on most barriers presented but some may not have encountered some barriers personally and therefore would not have a strong opinion.

For each barrier, a relative score (total score received divided by possible maximum x 100) was calculated. Missing or not-sure answers were omitted because there were no proven

correlations between variables (Dray & Josse 2015). We subjected survey responses to principal component analysis (PCA) (Abdi & Williams 2010; Bryant & Yarnold 2010; Vyas & Kumanarayake 2006).

Survey respondents were also asked about organizational attributes: countries of operation (later grouped into continents: Africa, Asia, Australasia, Europe, North America, other, and multinational), size (based on annual financial turnover : 5 groups from <£10,000 to >£1 million [NCVO 2015]), age (categories from Cameron and Whetten [1983]), and autonomy (independent, associated with a larger group but operating autonomously, or part of a larger organization).

We tested the 3 main assumptions that needed to be met before conducting a PCA: sphericity (Bartlett chi-square test), sample adequacy (Kaiser-Meyer-Olkin [KMO] test), and positive determinant of the matrix (built in function of R) (Schumacker 2016).

The selection via PCA of the smallest number of PCs that together account for the majority of the variance in the correlation matrix, is subjective, and there are many different methods for determining the number of factors to extract (i.e., retain) from the analysis (Bryant & Yarnold 2010). We considered 2 methods. First, using the Kaiser-Guttman stopping criterion, we selected only those PCs with eigenvalues ≥1 (Jackson 1993). This corresponds to an estimate of the effective dimension of subspace in which the data variations are largest (Polakow & Gebbie 2008). Second, we considered the scree plot, in which the eigenvalues in the steep descent are retained and those in the gradual descent (including those in the transition from steep to gradual descent) are dropped (Bryant & Yarnold 2010).

In analyzing our PCA results, we ignored typical cutoff points for factor loading (e.g., 0.30 [Bryand & Yarnold 2010]) because they are arbitrary (Vyas & Kumaranayake 2006). Because PCA loadings are additive, any that are not 0 are useful. To identify the most

influential barriers, we chose only those with the highest (most positive) or lowest (most negative) loading for each PC (Jolliffe 1986). Due to the subjectivity associated with PCA, we used a conceptual-sense check to compare the barriers not included in the strongest positive and negative barriers against those that were included.

We used linear discriminant analysis (LDA) (Henderson & Seaby 2008) to determine whether there were significant differences between groups based on multivariate *F* tests and which variables had significantly different means across the groups (Poulsen & French 2004). In the LDA, we used Wilks' Λ to test the null hypothesis that population means of different groups (dependent variables) are equal: a small Λ indicates differing group means (Schumacker 2016).

Using the smaller number of barriers identified via PCA as per the Kaiser-Guttman stopping criteria (Jackson 1993), we employed LDA to determine whether there were differences in the importance ascribed to individual barriers based on where organizations operate (continent of operation); their size, age, and autonomy; and whether we could identify which barriers were responsible for those differences. Chi-squared tests were run with Yates's correction to test classification of the models. An essential feature of LDA is the classification of items into mutually exclusive groups given knowledge of the independent variables (Schumacker 2016). We computed the percent correctly classified to check reliability of the results.

All statistical analyses were run in R (R Core Team 2017) with packages Psych (Revelle 2017), Rela (Chajewski 2009), and MASS (Venables & Ripley 2002). For both the PCA and LDA, not-sure answers were replaced with median scores in accordance with common practice.

Results

The survey response rate was 19.3% (154 completed of 797 delivered email invitations). This is lower than the average response rate of 34% for online surveys (Shih & Fan 2008), but it is within 1 SD of the average and therefore acceptable (Baruch & Holtom 2009). That our study participants were asked about issues unrelated to them personally suggests the risk of bias from low response rates is low (Peytcheva 2013). Although some respondents did not provide answers to all queries, all respondents who started the Likert section completed it.

For Bartlett's sphericity test χ^2= 4,575.5. Because this was greater than the critical value of χ^2=1,632.4 (p< 0.0001, df=1,540), the PCA achieved a significant reduction of the original data set's dimensionality. The sample size was adequate (KMO=0.8198). The determinant of the correlation matrix ($2.07x10^{-25}$), although small, was positive, indicating that we extracted variance. All 3 assumptions for conducting the PCA were therefore met (Schumacker 2016).

The PCA showed there was much overlap in the barriers presented (Tables 1 & Supporting Information) and the possibility of obtaining the same information by considering fewer barriers. The largest variations in the data were represented by 12 PCs (Supporting Information). The first 4 accounted for 53% of the variation, and all 12 accounted for 73.7%. These 12 PCs revealed 21 barriers with the strongest positive and negative influence (Tables 1 & Supporting Information). Our scree plot (Fig. 2) showed that the sharpest drop was between PCs 1-4; the first 12 PCs had Eigenvalues >1. When we ran the PCA with Varimax rotation, we found the same overall results.

In mapping all barriers from the survey to those with the strongest positive and negative influence, all could be mapped to at least 1 of our 21 key barriers as identified by the PCA (Table 1, last column).

A projection of the first 2 PCs onto a 2-dimensional eigenvector space showed that our barriers existed in a 90° arc in only 2 quadrants (Fig. 3). The angles between the segments

showed the correlations (0°, correlation 1; 90°, correlation 0). If we assumed any question asked was as useful as its opposite (e.g., short = not tall), a barrier phrased in the inverse would simply produce the opposite coefficient. Given that our 21 barriers existed in a 90° arc in only 2 quadrants, we assumed there were no inverse or missing barriers in our list. Our list therefore appeared to provide good coverage of barriers to conservation.

Wilks' Λ was small and significant for continent of operation and organization size (independent variables [Table 2]). Full LDA results for continent and size are in Supporting Information. When we computed the percentage of correctly classified barriers, over 54% of them were correctly classified significantly in all organization attributes (Table 3), suggesting good reliability of the results

Discussion

We used insights obtained directly from conservationists to identify which external barriers to conservation are most important when trying to understand operating context. Due consideration of these in planning and conducting conservation work could increase the success of conservation interventions.

Key findings

Our first key finding was that professionals working internationally across continents concur with each other on the barriers to conservation previously raised in face-to-face interviews with a predominantly African-based conservationists (Sanders et al. 2019). The relative scores (Table 1) of all barriers exceeded 50%, suggesting all were considered somewhat important. Although the range of scores was wide (51- 89.6%), no barrier received a relative score of 100%. Thus, no single issue was routinely ranked as extremely important by every

respondent. Instead, variability in importance suggested that context is specific, a conclusion further validated by LDA results.

Our second key finding was that barriers identified previously could be streamlined into a more parsimonious list without losing information. The subjectivity of the method, however, means that any hard cutoff points for including or excluding barriers in the conceptualization of context would be meaningless. Instead, the method lends itself to suggesting prioritization of barriers.

Emergent Themes

Principal components are like the colors in a painting. While they create the painting, the focus is on the picture created, not the colors themselves. Combination of our most influential PCs and linear discriminants (LDs) allowed us to create a picture of conservation context. - We grouped the most influential barriers (Table 3) into themes and considered why those particular barriers were influential. We considered only the first 4 PCs because they showed the strongest decline in the scree plot and accounted for more than half the variation in the data. For LDA, we considered the most influential barriers in the first 2 LDs for continent of operation and organization size because they accounted for over 70% of the variation. In most cases, there were 2 most influential barriers for each PC or LD, one with the strongest positive influence and one with the strongest negative.

The first theme was community attributes. A lack of understanding by conservationists about the structure of communities or dynamics between people within groups (barrier [B] 38) was most influential for PC1. Contrary to being the homogenous groups they are often assumed to be (Agrawal & Gibson 1999), communities have complex structures and unpredictable internal workings (Rambaldi et al. 2006). Empowerment of or benefits to one group can

negatively affect others (Borrini-Feyerabend & Tarnowski 2005). Misunderstanding these complexities can lead to conservationists making inappropriate decisions regarding how receptive the community is to its work and how best to structure that work to manage conflicts and sensitivities.

The lack of local community buy-in (B21) was most influential in PC4. Local opposition can hinder conservation initiatives and even contribute to anticonservation behavior (e.g., Eneji et al. 2009), whether or not communities are engaged in the conservation action (Bennett & Dearden 2014). In designing conservation initiatives, it is essential to identify what local people value and want to achieve (Sheil et al. 2008) because conservation success, particularly in developing nations, relies on local support to sustain results (Rodríguez et al. 2007; Bennett et al. 2019).

The availability and distribution of funding was the next emergent theme . The most influential barrier for PC2 was a lack of funding for conservation (B16). Although conservation funding has increased (Miller et al. 2012), threats to biodiversity and the number of organizations competing for funding are growing globally (Igoe & Kelsall 2006). Recent cost estimates suggest meeting global conservation targets will require funding to increase by at least an order of magnitude (McCarthy et al. 2012).

Overconfidence of conservation organizations (B29) was the second most influential barrier for PC2. There has been significant redistribution of charitable sector spending from smaller to larger organizations (Birtwhistle & O'Brien 2015); a small minority of NPOs now receive over 50% of all environmental charity income (Straughan & Pollak 2011; Clifford et al. 2013). In Africa 10 NPOs manage >80% of conservation expenditure (Brockington & Scholfield 2010). These large NPOs either conduct work themselves, or regrant to local groups, often doing so in agenda-setting ways (Chapin 2004; Sachedina 2011). These specified approaches, which tend not to engender community ownership or adequately

integrate diverse natural, socioeconomic, and cultural systems (Rodríguez et al. 2007) are often ineffective, but their use prevails because they meet donor requirements, even though local agencies could develop more effective approaches more suited to the needs of local communities (Smith et al. 2009).

The prevalence of conservation spending through large international NPOs in developing nations may explain why overconfidence of conservation organizations was also most influential for LD2 for continent of operation. Similarly, pervasiveness of channeling funds through either international NPOs or multilateral or bilateral aid agencies, particularly in Africa (Nelson 2009), may explain why donors setting and changing conservation agendas (B19) was most influential in PC3 and in LD2 for continent of operation.

Safety and security of conservationists (B33) was the next theme arising from the PCA; this point was most influential in PC3. A desire to conserve natural resources often conflicts directly with more ambitious development goals, particularly in poorer countries. During 2017 alone, 197 people were killed for defending land, wildlife, or natural resources (Watts 2018). Furthermore, outbreaks of disease or local unrest can endanger conservationists working in poorer countries.

The final barrier heavily influencing the PCA results was corruption (B5). This problem also explained 52.7% of the variation in the data in LD1 for continent of operation. The web of corruption includes government officials, police, rangers, and community members (e.g., see https://www.bbc.co.uk/news/world-africa-43821674). Corrupt practices involve bribery, fraud, extortion, and favoritism (Luo 2005) and often prevail in developing countries, where government salaries are low, regulatory institutions weak, and accountability limited (Laurance 2004). Corruption may be exacerbated by opportunity for financial gain (Smith et al. 2015). The increased prevalence of corruption in developing countries could explain why it was given more importance by people operating in developing countries.

Our results showed that lack of an enabling environment (i.e., ineffective policies, poor legislation, etc.) (B3) was most influential for LD1 for continent of operation and for LD2 for NPO size, suggesting it is more influential in some countries than others and in small organizations than large. Top-down governance of natural resources has had to make way for more diverse governance systems in which networks of actors cooperate to achieve policy objectives (Lange 2008). While this can ensure the needs of many different stakeholders are taken into account in devising and implementing policy, there is potential for fragmentation, duplication, and competing policies and agendas. This impediment to effective management and use of environments (Morrison et al. 2004) can be pronounced where governance quality is poor (Moore 2004) and levels of political corruption are high (Smith et al. 2003). Top-down governance can also prevail in developing countries, where implementation and enforcement of environmental legislation is constrained by a lack of political will and deficiencies in support, resources, and professional training (Lane 2008) and by inadequate public awareness of environmental laws (Clarke & Jupiter 2010). Because smaller organizations have less flexibility in their budgets (Rochester 2005), they have fewer resources and therefore flexibility to tackle external barrier. Poor enabling environments can therefore affect them more.

The final notable barrier we identified was the lack of core funding for conservation organizations (B17), which was most influential in both LD1 and LD2 for size. Across the charitable sector, there is a fixation on overhead reduction that results in underinvestment in organizational infrastructure (Lecy & Searing 2015). The common unwillingness to provide general operating support to NPOs can be particularly debilitating for small, community-based organizations (Cohen 2007) that find it difficult to find funding for their work (Jepson 2017). As a result, it is increasingly challenging for them to build up and maintain adequate infrastructure (Woodwell 2007). Whereas larger NPOs tend to have more stable funding

reserves, small and midsize organizations face heightened pressures when overall funding declines (Philanthropy UK 2008).

Practical applications

We distilled a large number of external barriers and highlighted those that most affect conservation practice. A tangible, manageable list of these barriers provides an accessible way for NPOs and funders to consider the context in which conservation occurs. To be successful, interventions need to address the right barriers – even if they are seemingly remote from day-to-day activities. The ability to respond to external barriers in real time will give NPOs more confidence to achieve their desired outcomes, effectively constrain challenges and threats to acceptable levels, and make informed decisions about exploiting opportunities (Grant 2012). Similarly, donors could use this information to make their grant making more effective. Undertaking due diligence in a selection process can help donors distinguish NPOs more likely to succeed (Woodwell 2007). This process should survey not only an NPO's work, but also its key risks, strengths, and weaknesses, allowing the donor to develop a well-rounded picture of the organization (Unwin 2004). Consideration of external barriers as part of this process can help enhance the effectiveness of grant making by ensuring that funds are awarded to the most locally appropriate interventions and not just through a small number of NPOs that then set the agenda. Our findings would be a good start point for this.

Because PCA is descriptive rather than inferential, we recommend using our list of barriers as a prioritization tool rather than a definitive solution. When trying to understand what could affect goal attainment, we recommend considering the most influential barriers (Table 4) as a first step for any organization. Others can be added as appropriate for the size, complexity,

and location of interventions. This practical application of our prioritization list would allow organizations to develop more risk-based, strategic, and adaptive management plans and to assess whether consideration of this broader set of barriers will help them plan, execute, and evaluate interventions and achieve their goals. With biodiversity levels continuing to plummet (Butchart et al. 2010; WWF 2018), conservation is more important than ever. Unless the most important barriers to on-the-ground conservation can be addressed, it is unlikely the wilderness landscapes desperately needed to prevent destruction of Earth can be sustained.

Study Limitations

In designing our study, we made every attempt to control for risks to its usefulness. However, there may be some concerns with generalizability of our findings. Because we used nonprobability sampling, our results are not completely representative of the views of the entire conservation community (Bryman 2016). Obtaining that level of representativeness is not possible. Only English speakers and computer users were able to participate. We did, however, obtain a reasonable spread of respondents from different categories within most organizational attributes (Fig. 1), suggesting that the views of different organizations were adequately captured. The only possible exception was autonomy; the majority of organizations were independent.

There have been concerns that high levels of nonresponse in surveys increase the risk of bias, but a low response rate does not necessarily translate into nonresponse bias. Peytcheva (2013) explains that the risk of bias is only increased when participants are closely involved with the survey topic or with the sponsor. In a survey on drug use, for example, drug users are less likely to respond, thus increasing the risk of nonresponse bias. In our study,

conservationists were asked about issues unrelated to them personally, thereby reducing the risk of nonresponse bias in our study.

There is a risk that respondents picked barriers based on a snapshot of what is currently happening, meaning our results could be quickly invalidated. We believe some of these limitations were overcome by our original list of barriers (Sanders et al. 2019). It would, however, be interesting to repeat this study in future and compare results to see whether and how prioritization of barriers have changed. Conducting further work in individual locations and with different types of conservation could help identify barriers more specific to individual contexts.

There was a risk of respondent fatigue given the large number of questions in the survey. Although there is strong evidence that such concerns are overstated (Hess et al. 2012), we conducted an informal analysis of the number of responses for each question (result not shown) to check for evidence of fatigue in our respondents. We did not see a reduction in responses to later questions. Given that the first drop off in response levels for online surveys tends to occur after 18 minutes (Duffy et al. 2005) and our survey would have taken less than this to complete, we believe this risk is minimal, but still worthy of mention.

For interviews and surveys, there is evidence that acquiescence (social desirability) bias exists (Kankaraš & Moore 2011). This bias tends to be larger for respondents with less knowledge and interest in the topic (Ornstein 2014). Because we asked senior-level conservationists to rate issues outside their control rather than provide information regarding their own behaviors or morals, we believe the risk of this bias affecting our results is extremely low.

Acknowledgements

We thank Synchronicity Earth and the University of Oxford's Department of Zoology and Merton College for providing the funding to undertake this work and D. Polakow for his advice and guidance on the statistics applied. We also thank all survey respondents for giving up precious time to complete our survey.

Supporting Information

The source of information for conservation organizations operating in each location (Appendix S1), full text of the survey (Appendix S2), pattern matrix from the PCA (Appendix S3), and complete LDA results for continent of operation (Appendix S4) and size (Appendix S5) 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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Table 1 Relative score assigned to barriers to conservation in a survey of 154 conservation professionals, principal component (PC) that barriers with the highest and lowest influence loaded to, and the PCs capturing barriers that are not one of the 21 most influential (i.e., with a highest or lowest loading).

Survey question number	Barrier	Relative score [a]	PC[b]	Barrier captured in PC
38 [d]	lack of understanding of community structure and dynamics by conservation practitioners	68.1	-1	
16 [d]	lack of funding for conservation	82.0[c]	2	
29 [d]	overconfidence of conservation organizations	51.3	-2	
33 [d]	security and safety problems for conservation practitioners	54.3	3	
19 [d]	donors setting and changing conservation agendas	69.3	-3	
5 [d]	corruption	69.8	4	
21 [d]	lack of local community buy-in	68.2	-4	
17 [d]	lack of core funding for conservation organizations	85.2[c]	5	
2 [d]	lack of political will	89.6[c]	-5, 6	

56 [d]	consumerism and western ideals	76.7	-6	
3 [d]	no enabling environment (e.g., ineffective policies, poor legislation, etc.)	81.8[c]	7	
52 [d]	industrial scale activities (mineral extraction, logging, plantations, etc.)	83.5[c]	-7, -9	
35 [d]	the way people are educated in the communities in which conservation organizations operate	67.9	8	
40 [d]	conflict between neighboring communities	53.3	-8	
46 [d]	conservation activity attracting more people to sensitive areas	55.2	9	
6 [d]	economics and the need or desire for development	80.5	10	
55 [d]	growing population	82.4[c]	-10	
48	many people competing for limited resources	78.5	11	
1 [d]	weak government institutions	87.6[c]	-11	
43 [d]	ill conceived incentive schemes	63.2	12	
15 [d]	general lack of discussion about, and learning from, failures	68.9	-12	
18 [d]	short-term nature of conservation funding	85.7[c]		2, 3, 5

4 [d]	ineffective law enforcement	83.9[c]	4, 5, 6, 7, 11
10 [d]	no integrated approach that considers both conservation and underlying causes of damage to natural resources	82.9[c]	1, 2, 3, 4, 7, 9, 10, 11
49	competition for land (mining, golf courses, grazing, tourist spots, etc.)	81.0	7, 9, 8, 10, 11
51	extraction of resources for profit or business use	80.5	6, 7, 9, 10
37	lack of capacity in local government	77.7	5, 6, 11
8	natural resources seen as external to humanity	74.6	2, 3, 5, 6, 8
12	lack of land-use planning	73.9	7, 9, 10, 11
36	lack of capacity in local communities	71.5	1, 4, 8
25	interventions planned or delivered with little understanding or consideration of local context	70.7	1, 2, 3, 4, 7, 8, 9, 11
20	donors failing to select the most effective organizations	70.2	2, 3
53	lack of clarity over land tenure and ownership	70.0	1, 4, 8, 9
27	lack of appreciation by international donors and NGOs for how things work in different countries (e.g., things can take	69.4	1, 2, 4, 5, 6, 7, 8, 11

	longer in Africa, per diems are expected in some cultures, etc.)		
23	lack of local community ownership	69.0	1, 2, 4, 8, 12
47	human-wildlife conflict	68.0	3 , 4, 5, 6, 8, 9
11	inability to work at a landscape scale	68.0	2, 3, 5, 8, 10, 11
44	inappropriate alternative livelihood interventions	66.6	1, 3, 4, 8, 11, 12
42	lack of employment opportunities for local people	66.4	1, 4, 6, 8
9	conservation seen as an elitist issue and only as nice to have	66.0	2, 3, 4, 5, 6
24	communities seen as external to conservation	65.9	2, 3, 4, 8
22	lack of trust by local communities	65.4	2, 3, 4, 5, 6, 8, 11, 12
13	lack of collaboration between conservation organizations	64.5	2, 3, 12
34	how people are educated globally	64.2	6, 10
14	poor knowledge sharing within the sector	63.8	2, 12

26	prevalence and promotion of western models of conservation	63.4	2, 3, 4, 12
50	extraction of resources by local people for food or personal use	63.1	4, 8, 11, 12
41	inequality of benefits derived from conservation interventions	62.5	1, 8, 12
45	creation of dependency on conservation or development organizations	62.5	2, 3, 4, 8, 12
7	poverty	61.5	1, 2, 4, 5, 6, 8, 11
31	conflict or war where conservation organizations operate	59.4	3
54	evictions in the name of conservation	55.6	2, 3, 4, 8
28	disconnect between head office staff and those working on the ground in conservation organizations	53.8	1, 2, 12
39	heterogeneous nature of local communities	53.2	1, 4, 8
30	poor local infrastructure (e.g., unsuitable roads, lack of fuel or vehicles, etc.)	51.2	3, 5, 7
32	outbreaks of disease where conservation organizations operate	51.0	3

[a] Relative score is calculated as score received divided by total possible score x 100.

[b] The PCs for which each barrier is most influential (positive and/or negative).

[c] One of the 10 highest relative scores.

[d] Barriers with at least 1 most influential PC or 1 of the 10 highest relative scores.

Table 2: Results of the linear discriminant analysis used to test whether the importance ascribed to individual barriers differed in organizations of different sizes, ages, levels of autonomy, or continents of operation.

	Continent of operation	Size	Age	Autonomy
LDA null hypothesis test results				
Linear discriminants	6	4	4	2
Wilks' lambda	0.2086	0.3326	0.433	0.5975
df	6	4	4	2
F (approx.)	1.347	1.370	1.07	1.370
df	126, 547	84, 356	84, 382	42, 196
p	0.013	0.027	0.33	0.080
Correct classification test results				
correct classification	58.3%	90.1%	61.7%	54.5%
χ^2	222.67	44.36	142.35	84.99
df	36	4	16	16
p	< 0.0001	< 0.0001	< 0.0001	<0.0001

Table 3: Summary of barriers to be considered due to their most positive or most negative influence in the first 4 principal components (PC) and the first 2 linear discriminants for continent (LDC) and size (LDS).

Survey question number	Barrier	PC	LDC	LDS
38	lack of understanding about community structure and dynamics by conservation practitioners	-1		
29	overconfidence of conservation organizations	-2	2	
16	lack of funding for conservation	2		1
19	donors setting and changing conservation agendas	-3	-2	
33	security and safety problems for conservation practitioners	3		
21	lack of local community buy-in	-4		
5	corruption	4	1	
17	lack of core funding for conservation organizations			-1, -2
3	no enabling environment (e.g., ineffective policies, poor legislation, etc.)		-1	2

Figure 1: Continent of operation, age, size, and autonomy (i.e., organizational independence) of organizations represented in a survey of 154 conservation practitioners to identify barriers to conservation (series numbers refer to xxx).

Figure 2: Contribution of each principal component (PC) to the variation in the data obtained in the identification of barriers to conservation from 154 survey responses.

Figure 3: Projection onto the 2-dimentional eigenvector space of the 21 barriers to conservation identified in the principal components (PC) analysis (Q, xxx).