

RESEARCH ARTICLE



An international assessment of the barriers influencing the effectiveness of island ecosystem management

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Abstract

1. Island ecosystems are disproportionately impacted by biodiversity loss and as such their effective management is critical to global conservation efforts.
2. Practitioners world-wide work to manage island sites and species to conserve them, but various day-to-day barriers compromise these efforts, reducing management effectiveness and preventing local and potentially even national biodiversity targets from being met.
3. Identifying the most important barriers that currently impede effective island conservation could streamline investment to focus on cost-efficient interventions that better reflect realities on the ground and the need to address barriers under substantial time and budget constraints.
4. A survey of 360 practitioners working in island ecosystem management across 77 countries was conducted.
5. The three most common barriers perceived by practitioners to prevent them from achieving more effective management are: low staff capacity; difficulties turning data into useful information for management (including lack of capacity and time to analyse data); and lack of a research and management strategy.
6. Practitioners' perceptions of national-level management effectiveness were mostly associated with their perception of governance issues, the presence/absence of research and management strategies and their experience of collaboration outcomes.
7. Practitioners' experience of staffing and monitoring programme issues was important in shaping their perception of management effectiveness within the organisation(s) they worked with.
8. Despite the indisputable need for transformative change to address the underlying causes of many of these barriers, more immediate and direct investment in strengthening the people and systems that are at the frontline of preventing biodiversity loss on islands is needed to bridge these barriers and achieve more effective management of island ecosystems.

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KEYWORDS

biodiversity, capacity, conservation, practitioners, small island developing states, social survey

1 | INTRODUCTION

Collectively, the world's islands host around 20% of global biodiversity and yet have suffered 61% of recent extinctions (Tershy et al., 2015). Today, islands vary greatly in their developmental and geopolitical status, which has implications for their vulnerability and response to the direct and indirect drivers of biodiversity loss (IPBES Chapter 2.1; Balvanera et al., 2019). This is especially true for small island developing states (SIDS), which are disproportionately impacted by environmental pressures, yet have less resources or capacity for managing them (Cherian, 2007; Thomas et al., 2020; van der Velde et al., 2007). Regardless of these differences, conservation and sustainable management of island ecosystems is a priority for island nations, whose populations rely on the services they provide (Mouillot et al., 2020). As such, practitioners world-wide work to manage island ecosystems through active conservation and sustainable management. Despite many successes, these efforts are hindered by a raft of barriers operating from site/project level up to national level, impeding practitioners from achieving conservation and management goals (Burt et al., 2021).

So far national and global biodiversity targets have been missed by a wide margin and these failures have been attributed in part to inadequate national policy responses (CBD, 2010, 2020). Many factors are likely to be contributing to failures, so understanding which barriers are perceived to be impacting national-level management effectiveness is crucial to informing the effective design and implementation of the post-2020 Global Biodiversity Framework (GBF; Xu et al., 2021). The effectiveness of management at site level may be minor in the outcome of global targets, but cumulatively, site-level actions, such as species protection, setting fishery quotas, habitat restoration and invasive alien species removal, if effective, ought to play a role in achieving national targets. However, site-level management often lacks the basic requirements to operate effectively (Leverington et al., 2010).

To identify which barriers practitioners face in achieving effective management, various interviews and surveys of frontline staff have been conducted (e.g. Bottrill et al., 2011; Burt et al., 2021; Forster et al., 2011; Sanders et al., 2019). The practitioners in these studies described barriers operating at different levels of management, but with some clear and consistent themes. At site/project level these include skill gaps in data management and analysis, poor monitoring or research design and inadequate staffing or roles to achieve objectives (Burt et al., 2021; Forster et al., 2011; Lindenmayer et al., 2013). At organisation level they include staffing and resource limitations and limited collaboration and communication between practitioners and organisations/institutions (Burt et al., 2021; Forster et al., 2011; Sanders et al., 2019). More broadly, at the national level, practitioners have described barriers caused by poor education, governance issues, institutional capacity and limited coordination of efforts (Bottrill et al., 2011; Burt et al., 2021; Forster et al., 2011; Sutherland & Wordley, 2017). While these surveys have

helped to define what barriers exist and highlight the need to bridge them, their focus on single geographic regions hinders our ability to identify patterns and draw recommendations at wider scales. In addition, understanding not only which barriers are faced (as most previous studies focused on) but also their prevalence can help us set priorities and inform the development of collaborative efforts towards addressing them (von Bieberstein et al., 2019).

Furthermore, knowing which barriers are most commonly experienced does not necessarily reveal which ones most strongly shape a practitioner's overall view of management effectiveness. For example, if all practitioners in a survey identify insufficient funding as a major barrier to effective management, but some still perceive management to be effective in spite of this, we would have to look elsewhere to explain variation in their overall views of management effectiveness. Limited attention has been given, however, to understanding the relative importance of specific barriers on management effectiveness. Understanding which barriers play a greater role, and identifying which solutions practitioners believe could most effectively bridge these, should provide much-needed insights into the potential levers for improving management effectiveness.

In this study we developed an online survey based on barriers previously described by island ecosystem management practitioners from island nations in the Western Indian Ocean (Burt et al., 2021). The survey was circulated through international networks of practitioners and engaged people working in island ecosystem management. The survey was designed to address three key questions: (1) what are the most common barriers that island practitioners experience in working to meet island ecosystem management and conservation objectives?; (2) how does the prevalence of particular barriers shape practitioner views of national- and organisation-level management effectiveness of island ecosystems?; and (3) which of the proposed solutions to bridging these barriers have the highest support from practitioners? By identifying the most important barriers that currently impede effective island conservation and management, we can streamline investment to focus on cost-efficient interventions that better reflect realities on the ground and the need to address barriers under substantial time and budget constraints (Johnson et al., 2017; McCarthy et al., 2012; Xu et al., 2021).

2 | METHODS

2.1 | Data collection

Survey approach and design

This study is informed by a preceding series of exploratory semistructured interviews with 32 conservation and management practitioners from island nations in the Western Indian Ocean (Burt et al., 2021). This was done as a scoping exercise to identify the type

of day-to-day barriers that practitioners face in their efforts to meet conservation and management objectives. The interviews identified 33 barriers under 12 overarching themes across national, organisation and project/site level (see [Table S1](#) for details). In this study, we used these findings to inform the structure and content of a more detailed questionnaire to quantify the prevalence of these barriers at broader scales and explore their overall impact on perceptions of management effectiveness.

The survey (English version in supplementary material 1) consisted of 35 questions divided into 12 sections ([Figure S1](#)). Sections 1–4 aimed to gather information about the practitioners themselves, their main management objectives and the type and severity of threats they encounter at the site(s) they work with. Sections 5–7 aimed to quantify the barriers practitioners are facing at national, organisation and project/site level based on barriers identified during scoping interviews. In these sections the term 'low staff capacity' refers to specific staff skill sets rather than to insufficient staff numbers, which is listed as a separate barrier in this section. Sections 8–10 were included due to the frequent mentions on these topics in the scoping interviews, with sections 8 and 9 focused more intently on barriers to collaboration and data management and analysis, and section 10 aiming to quantify how many practitioners have access to scientific literature and whether there are barriers to their engagement with scientific evidence. In addition, section 11 aimed to quantify which solutions and skills would most enhance effective management, with these also being based on suggestions by practitioners in scoping interviews (Burt et al., 2021). Lastly, section 12 aimed to quantify practitioners' overall perception of management effectiveness. Not all sections and questions were relevant to all practitioners; for example, if a practitioner had mostly positive experiences of collaborations, they would skip the barriers to collaboration section, likewise if a practitioner was not involved in data management, they would skip the data management and analysis section. A variety of question types were used, including single-answer, multiple-choice and open-ended questions, but the majority of questions could be answered using grid-like responses and Likert-type scales. These allow responses from a range of ordinal options to achieve a semiquantitative assessment of the issues (Allen & Seaman, 2007).

Survey administration

The online survey was piloted to 30 practitioners in March 2020 (these were not included in the final dataset), revised, and launched on 30 July 2020, and closed on 31 January 2021. On average, the survey duration was around 15 min per participant.

We ran the survey in eight languages (English, French, Spanish, Portuguese, Arabic, Indonesian [Bahasa], Japanese and Malaysian), chosen to maximise participation throughout the global island practitioner community. To minimise bias towards the researchers' personal networks we circulated the questionnaire in four stages: (1) the survey was seeded to global networks of island conservation and management practitioners via mailing lists. These included the

IUCN Island Ecosystem Specialist Group, Global Island Partnership, UNESCO Marine World Heritage site managers' network and Island Biology Society; (2) once the survey had circulated through global networks, we targeted more specific, niche groups, including Coral-list, Aliens-list, Flora & Fauna International, Birdlife International and the Royal Society for the Protection of Birds; (3) we sent emails to colleagues and personal networks, specifically targeting regions that had a low number of early respondents (e.g. New Zealand); and finally (4) we posted the survey on social media, tagging additional network groups, some of whom then shared the post. Throughout each stage we employed respondent-driven sampling; this involves requesting those directly contacted to recruit additional respondents by sharing the survey within their networks of island ecosystem conservation and management practitioners. In total there were 360 respondents: 80 responses in stage 1; 110 in stage two; 130 in stage 3; and 40 in stage 4.

This study was approved by the University of Oxford Social Sciences and Humanities Interdivisional Research Ethics Committee (Ref No: R62246/RE002). The survey was administered only after obtaining the consent of each participant on the first page of the survey interface. Specifically, respondents were asked to check the tickbox if they agree to the following statement 'I have read the above information and agree to participate in this survey'. Participants were informed about the purpose of the project, the voluntary nature of their participation, the right to terminate the questionnaire at any time, and that any data disclosed in reports, scientific publications or presentations would be completely anonymous. Participants were also asked to respond based on their experience over the last 3 years and focusing on the organisation(s) or site(s) they have direct experience with. This was done to ensure our respondents were still active practitioners, clarify the time-scale they had in mind when answering questions and ensure they had specific site(s) or project(s) in mind from which they were drawing their direct experience.

2.2 | Data analysis

2.2.1 | Study participants

The non-English survey responses were back-translated to English using google translate. Data from Sections 1 and 2 of the survey were compiled to summarise descriptive information about the study participants, their role and the organisation(s) they work for. To assess the coverage of our circulation efforts we compared respondents' country of origin and country in which they have most experience of island ecosystem management, creating a new variable: national/nonnational. This is important both for ensuring our survey reached local practitioners and because we felt there could be differences in perceptions between these two respondent groups. We also used 'country of work' to create two new variables which grouped respondents by region and by their socio-economic and political characteristics (for brevity we

therefore used the categorisation 'Global North' or 'Global South'; see Table S2 for details). We included these variables because they may be important when considering respondent perceptions of island ecosystem management effectiveness, given the likely differences in resource and capacity levels between regions of differing economic status.

2.2.2 | Descriptive results

To summarise the survey data, the responses were collated to quantify the number of respondents for each statement response. These were used to create figures showing the percentage of respondents for each response type (Supplementary material 2). Additionally, for most questions the respondents were given the option to add additional comments and these comments have been used to illustrate points made in the discussion. In the solutions section, additional written responses were grouped based on the content theme (e.g. funding or capacity) and the frequency each theme was mentioned was tallied.

2.2.3 | Investigating which barriers are predictors of practitioner's perception of island ecosystem management effectiveness

Condensing Likert statements

Some Likert statements measured the same latent variable, for example, there were eight statements which measured a practitioner's perception of monitoring programme issues (e.g. lack of monitoring aims, lack of protocols). To create one variable which summarised the extent to which a practitioner had experienced monitoring programme issues we condensed these variables. To do this we converted Likert responses into numerical scale (e.g. always = 5, often = 4, sometimes = 3, rarely = 2, never = 1), and to verify the internal consistency across the statements we used Cronbach's Alpha (Psy package V1.1; Tavakol & Dennick, 2011). A high Cronbach's alpha score (>0.7) affirms a correlation in the responses across these statements and therefore they can be averaged to form one variable;

we therefore proceeded with condensing variables if Cronbach's Alpha was >0.7 .

To explore which factors are most important in forming a practitioner's perception of management effectiveness: (a) nationally and (b) within their organisation(s), we compiled a list of potential explanatory variables (see Table S2 for justification of inclusion) created from the survey responses. The response variables (overall perception of management effectiveness) were ordered; for example, respondents were asked to register a rating (very poor; poor; fair; good; excellent). While it is reasonable to assume that all participants will view the rank order of these potential answers in the same way, we cannot make assumptions about the distance between categories or their distribution. We thus used ordinal logistic regressions to explore relationships between the response variables and all potential explanatory variables. Categorical variables were recoded into a set of binary variables within the R MuMIn package v.1.42.1 (Bartoń, 2018). We used Akaike's information criterion (AIC) to select the most parsimonious models among all possible combinations (Burnham & Anderson, 2002). We averaged estimates across models with $\Delta AIC < 4$ using the MuMIn package v.1.42.1 (Bartoń, 2018); $AIC \geq 4$ indicating considerably less support for the model (Burnham & Anderson, 2002). Statistical analyses were conducted in R version 4.0.2 (R Core Team, 2020).

3 | RESULTS

3.1 | The survey respondents, sites and perceived threats

A total of 360 respondents completed the online survey (41 in the non-English versions). Not all participants answered all sections, so sample size varies per question, and is reported throughout. Respondents identified 77 different countries as their main country of work (Figure 1) of 107 countries which are, or have, islands. More than half (57%) of the respondents were nationals of that country and 61% were working in countries categorised as belonging to the Global South. The top 10 countries of response were Seychelles (43), the United States (40), Mauritius (19), Australia (17), New Zealand

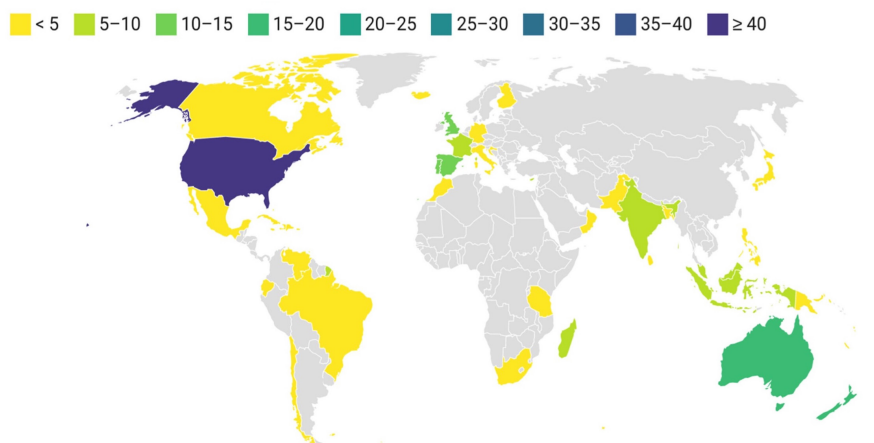


FIGURE 1 Online survey coverage of respondent's country of work in island ecosystem management and conservation, based on 360 practitioners. NB: Countries with high number of respondents but not seen on the map due to their size include Seychelles and Mauritius.

(17), Portugal (13), the United Kingdom (13), Saint Helena, Ascension and Tristan da Cunha (10), Spain (10) and Indonesia (8). Regional coverage ranged between 44 and 96 respondents per region, except for the Middle East (one respondent) and other Arab states (four respondents). We also had relatively equal coverage across the different roles within island ecosystem management, with the highest number of respondents identifying their role as a 'science officer/coordinator' (33%), followed by 'researcher/academic' (26%) and 'manager/CEO' (18%; [Figure S2](#)). Respondent experience varied across role type ([Figure S2](#)); overall 46% of respondents had >10 years of experience.

Respondents mostly worked with more than one type of site or area (70%; [Figure S5](#)) but overall, the main site type that respondents worked with was protected areas (82%) and national parks (41%). Most respondents worked with multiple sites that varied in remoteness (46%), with 14% of respondents working in sites >100 km from mainland areas ([Figure S6](#)). The most common management objectives for the organisation(s) that respondents worked with were: monitoring species and ecosystems (68%; [Figure S3](#)) and habitat restoration (65%), followed by research to inform management (58%) and site protection (55%; an interesting result considering 82% of practitioners worked with protected areas). Slightly less than half (46%) of respondents worked with multiple types of organisations, while 25% worked solely with nongovernmental organisations and 20% worked solely with government-led authorities ([Figure S4](#)).

Invasive alien species were perceived to be the biggest threat to the site(s) ([Figure S7](#)) with 56% of respondents ranking this threat as severe, followed by coral bleaching and mortality (36% of the 235 respondents whose sites included marine ecosystems, although important to note that not all these islands will have coral reef ecosystems), native habitat destruction for development (34%), plastic pollution (32%) and tourist impacts (25%). Threats perceived to have the most impact on management resources were invasive alien species (59%), habitat destruction (40%), illegal activities (28%), tourist impacts (27%), plastic pollution (23%) and coral bleaching and

mortality (19% of the 235 respondents whose sites included marine ecosystems; [Figure S8](#)).

3.2 | Barriers faced to fulfilment of management objectives

The most frequently experienced barrier overall was 'low staff capacity' (85% experienced this either always, often or sometimes; [Figure 2a](#) and [Figures S9–S12](#)) with 82% of respondents having to recruit volunteers to fill skill gaps within the organisation/s they work for. Following this were 'lack of data analysis capacity' and 'difficulties with turning data into information that can be used for management' (74% experienced these always, often or sometimes), and 'lack of time to analyse data' (72%). In addition, 70% of respondents experienced a 'lack of research strategy' and 61% experienced a 'lack of management objectives'. At national level the most common barriers were 'poor enforcement of conservation law' (64%) and 'poor conservation policy implementation' (61%).

Collaboration outcomes and barriers

When asked how frequently collaborations had positive outcomes, 55% of respondents felt that local collaborations often had positive outcomes and 50% felt that international collaborations often had positive outcomes ([Figure S13](#)). Respondents were also asked if collaborative reports or data sharing was rare, to which 59% of respondents agreed or strongly agreed ([Figure S14](#)).

The 139 respondents who felt that local collaborations only sometimes or rarely had positive outcomes were then asked to what extent they agreed with the 11 potential barriers to collaboration that we listed ([Figure 2b](#) and [Figure S15](#)). The most widely perceived barriers to local collaboration were 'egos, personalities and interpersonal issues' and 'lack of coordination by government' (86% of respondents either agreed or strongly agreed with both), followed by 'strong sense of ownership over data, species, or

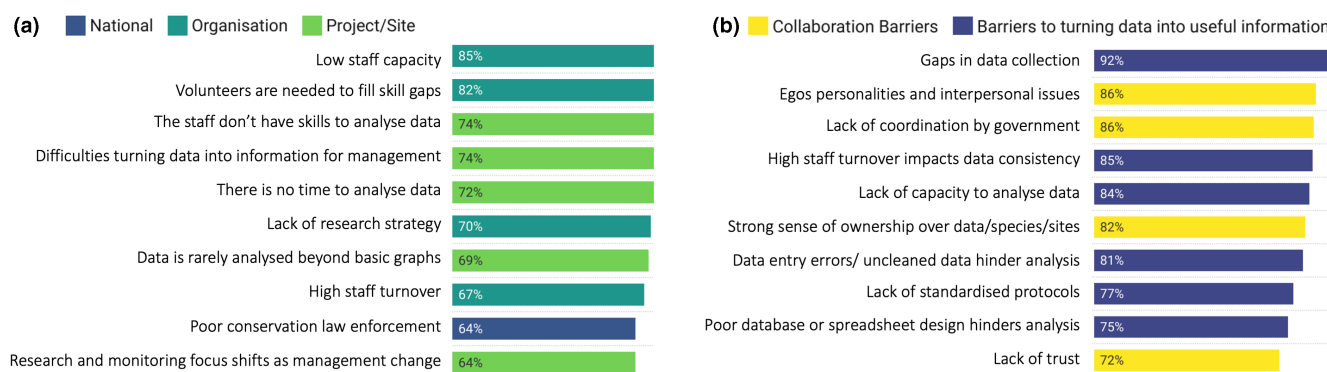


FIGURE 2 The top 10 most frequently experienced barriers to: (a) the fulfilment of management, conservation or research objectives at national level (respondents were asked to tick all that apply), organisation level and project or site level (percentage of respondents whose Likert responses were 'always' + 'often' + 'sometimes'; based on 360 respondents) and (b) to collaboration (Likert responses 'strongly agree' + 'agree') and barriers to turning data into useful information for management (Likert responses 'always' + 'sometimes'). For the full results see [Figures S9–S12](#).

sites' (82%) and 'lack of trust' (72%). Of note, over half of respondents (55%) had previously had 'bad experiences of collaboration' (Figure 2b).

Data analysis barriers

A total of 341 respondents (97%) were directly involved in data management or analysis. Of the 12 potential barriers to data analysis and management we listed in the survey (Figure 2b and Figure S16), 42% of respondents had experienced 10 or more of these at least some of the time. The most frequently experienced barriers were 'gaps in data collection' (92%); 'high staff turnover impacting data consistency' (85%); and 'lack of capacity to analyse data' (84%). Over half (>53%) of practitioners had experienced the remaining listed barriers at least some of the time, with the exception of 'staff have been known to falsify data', which 24% of respondents had encountered sometimes or always (see Figure S16b,c for breakdown by country and role).

Access to scientific literature

Just under half (46%) of respondents agreed or strongly agreed that there was a lack of in-country access to scientific research articles (Figure S17) and 61% agreed that there was not enough time to read research articles, with 37% agreeing that scientific articles are difficult to understand.

3.3 | Overall perspective of island ecosystem management effectiveness

When asked at which level (national, organisation or project/site) the main barriers to effective conservation and management of island ecosystems occurred, 62% of respondents identified national, 25% organisation and 13% project/site level (Figures S18 and S19).

When asked to rate the current level of management effectiveness both nationally and within their organisation(s), 51% of respondents perceived that management effectiveness within their organisation was good or excellent; 32% considered it fair; and 14% perceived it as poor or very poor (Figure S20a). Those who perceived management to be very poor were mainly within government or consultants (Figure S20b). At national level, 14% perceived management effectiveness to be good or excellent, 39% perceived it to be fair and 42% of respondents perceived it to be poor or very poor.

3.4 | Predictors of perceptions of management effectiveness

After modelling respondent's perception of management effectiveness at national level against a series of potential explanatory variables (Table S2), the most important predictors were their

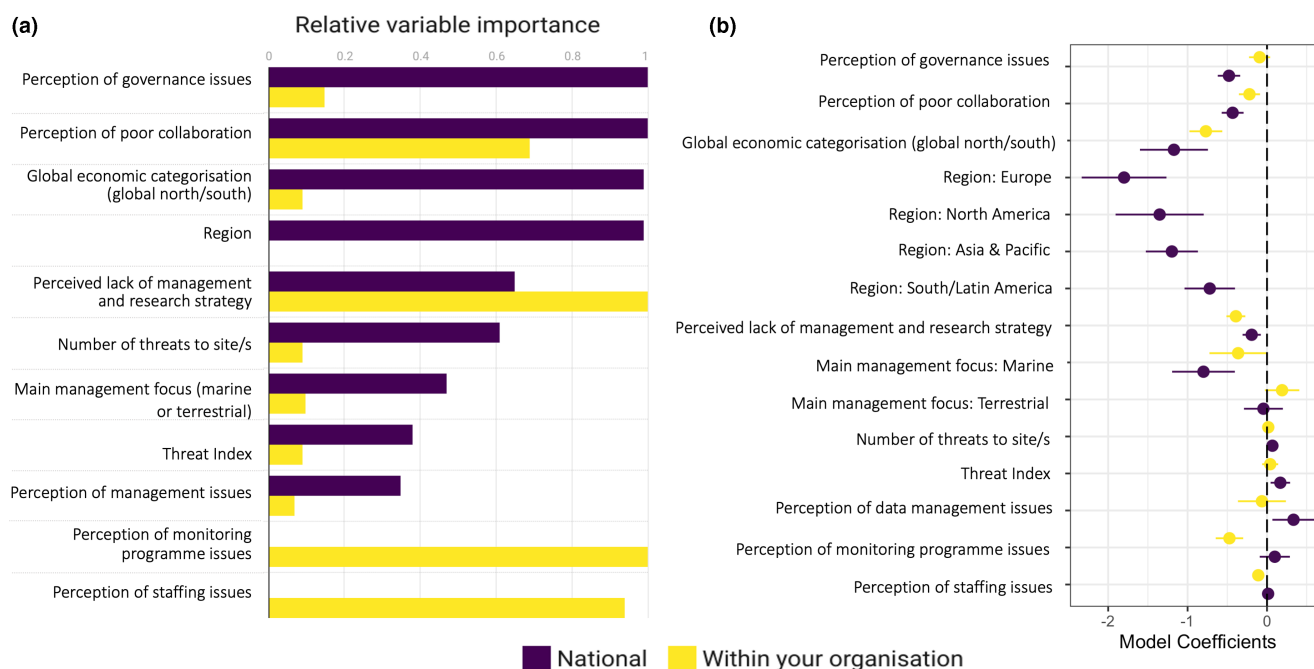


FIGURE 3 Model outputs obtained by averaging overall models in the top model set from the averaged ordered logistic regressions fitted to respondent's perception of management effectiveness (very good, good, fair, poor, very poor) both nationally and within their organisation. (a) Relative variable importance of predictor variables (expressed as the sum of the Akaike weights for the variables included in the averaged models), and (b) model parameter unconditional estimates; if the coefficient >0, then it results in an improved perception of management effectiveness (if <0, more negative perception). If the bars overlap zero, then you cannot confidently assess whether the variable dictates a more positive or negative perception but the variable itself might still be important. Categorical variables were recoded into a set of binary variables within the R MuMIn package v.1.42.1 (Bartoń, 2018). For data see Tables S3 and S4.

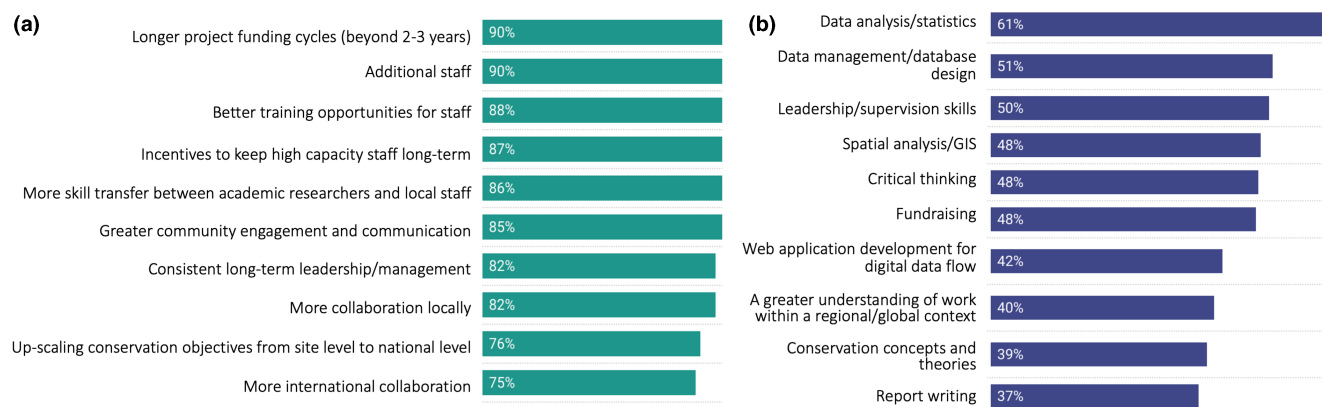


FIGURE 4 The top 10: (a) potential solutions listed that respondents felt would most improve management effectiveness of the site/s they work with (percentage of respondents whose Likert responses were: 'greatly improve' + 'Moderately improve'). Based on a subsample of 276 respondents and; (b) skills and training needs that respondents felt would assist in achieving management objectives. For the full results see Figures S21–S24.

experience or perception of 'governance issues', 'collaboration' and the presence/absence of a national 'research and management strategy' (Figure 3a). In addition, whether they are from countries categorised as Global South or Global North, the region they are from, and their main management focus (marine or terrestrial, or both) were important in shaping their perception of national management effectiveness (Figure 3a, Table S3). Perception of national management effectiveness was more positive in the global north and where the management focus was mainly on terrestrial ecosystems (Figure 3b).

When considering the perspective of respondents on overall management effectiveness within the organisation(s) they work for/with, the most important factors were the presence/absence of a 'research and management strategy' within the organisation and their experience of 'issues with monitoring programmes', 'staffing issues' and 'collaboration' (Figure 3a; Table S4). Their perception of organisational management effectiveness was less positive where practitioners perceived more issues with monitoring programmes, a lack of research and management strategy and if they experienced more staffing issues (Figure 3b).

3.5 | Support for potential solutions and training needs

Overall, 276 respondents (77%) completed the solutions section of the online survey. Of the 19 listed potential solutions, the greatest support from respondents was for 'longer funding cycles' and 'additional staff' (90%; Figure 4a, Figures S21–S23), followed by 'better training opportunities for staff' (88%) and 'incentives to keep high-capacity staff long term' (87%). The skills perceived to be most lacking by practitioners but that are needed to achieve management objectives were data analysis/statistics (61%), data management and database design (51%), leadership and supervision skills (50%), spatial analysis and GIS (48%) and critical thinking (48%; Figure 4b, Figure S24).

3.6 | Additional suggestions for improving management

Respondents were given the opportunity to elaborate on or add thoughts around potential solutions to improve effective management. The most commonly discussed solutions were the need for additional funding, greater diversification of funding streams and more staff (Table 1). A new idea not listed in the survey but raised by practitioners included the need for greater gender diversity and equality.

4 | DISCUSSION

We have found that the three barriers most commonly experienced by island ecosystem management practitioners are: insufficient capacity of staff; difficulties turning data into useful information for management (mostly due to lack of data analysis capacity and time constraints); and lack of a research strategy. In addition, a raft of barriers to collaboration hinders management connectivity between relevant actors. Importantly, the majority of practitioners had experienced most of the barriers listed in the survey at least sometimes. Our survey also reveals that these more common barriers are not the most important in forming practitioners' perceptions about management effectiveness. Instead, their opinion of national-level management effectiveness was mostly associated with their perception of governance issues, the presence/absence of research and management strategies and their experience of collaboration outcomes. The latter two factors were also important in shaping their perception of management effectiveness *within* the organisation(s) they worked with, along with their experience of staffing and monitoring programme issues. These findings paint a bleak picture; building on from previous studies which defined barriers experienced by practitioners within specific regions (e.g. Burt et al., 2021; Forster et al., 2011; Sanders et al., 2019), our results clearly show us that the majority

TABLE 1 Selected additional suggestions or comments from 52 respondents under the solutions section, ranked by the number of times they arose. New ideas not listed in the survey are in bold

Solution	# practitioners	Example quote(s)
Additional/diversification of funding	22	'ANY project funding, never mind "beyond 2-3 years"!' 'All of the above are key to carrying out effective management, developing a diverse revenue funding strategy would also help maintain consistency in these areas'
More staff/staff consistency	12	'Hiring of appropriate and most qualified staff for specific positions'.
Longer funding cycles	4	'Further, all grants available are short term (≤ 3 years) and do not address long-term conservation issues (tree conservation, ecosystem restoration)'
Higher education standards	4	'Improvement in university level education standards and training variety to produce AND RETAIN high calibre LOCAL graduates'
Greater political will and conservation prioritisation	2	'Political prioritisation of conservation' and 'National level support for conservation research and actions feels low, despite quite dedicated local staff and researchers'
More community involvement	2	'More community-based management, training local communities, and provide funding for capacity building & employment'
Management scrutiny	2	'Remove incompetent managers and directors. Grants and projects are written with vague objectives and deliverables'
Improved legislation and policy	2	'Improved legislation and policy. Climate change policies that are effective and beneficial to conservation'
Greater gender diversity and equality	1	'Greater gender diversity and safer places for females'
Training and mechanisms to deal with sexual harassment	1	'1. Creating mechanisms to report sexual harassment in the field to the organisation funding the research, and 2. training on sexual harassment awareness for all member of a research team going into the field, as well as 3. training to improve awareness of the impact of power dynamics for leaders going into the field with research teams'
Greater mentorship opportunities	1	'Learning on the job with good mentors helps with critical thinking and decision making'
Enforcement	1	'A strong commitment to enforce management plans'

of people undertaking frontline conservation of island ecosystems world-wide struggle to reach their potential as a result of barriers operating at multiple levels.

The aim of this survey was to specifically quantify the day-to-day barriers experienced by practitioners. We therefore did not include survey sections which relate to those less measurable underlying causes of barriers, which are outlined in the IPBES report (Balvanera et al., 2019), and broadly summarised as the factors behind the human choices that affect nature (e.g. governance, demographic, technological and economic). However, the respondents themselves highlighted them extensively (and passionately) within the additional comments sections throughout the survey, in particular the role that issues such as inequality, corruption, conflicting priorities, illegal activities, extreme poverty and neo-colonial pressures play in their ability to work effectively. Due to the differences in vulnerabilities to such issues, it is not surprising that we found that those respondents working in island ecosystem management in Global South countries were less likely to perceive national level management to be effective. With these underlying causes in mind, but with a desire to highlight more immediate and local level potential interventions, we discuss the main barrier themes and what can reasonably be done to bridge them, given appropriate resources.

4.1 | Governance

Practitioners overwhelmingly felt that the main barriers to effective management were at national level. As the majority of the respondents were working outside of government (only 13 within) this perception may arguably represent a bias or general shifting of blame. However, while our survey represents only the perceptions of practitioners, which are open to bias, practitioner perceptions are recognised as an indispensable form of evidence on how to improve conservation success (Bennett, 2016). We therefore argue that these perceptions are a valid and clear insight into where island practitioners feel the problems lie. Additionally, our analysis did not find respondent role (i.e. whether a respondent worked within government or NGO etc) to be an important variable in determining respondent's perception of management effectiveness. We acknowledge that with a greater proportion of respondents working within government this result may have been different.

Within the national context, the most commonly cited obstacle was 'poor conservation policy implementation and law enforcement', with over 60% of practitioners experiencing this as a barrier to their work. This finding corroborates the idea that Aichi targets have been missed due to inadequate national policy responses (Xu et al., 2021); that is, that National Biodiversity Strategies and Action Plans (NBSAPs) are poorly implemented or implementation is not sufficiently translated

into actions and results visible to practitioners. To integrate the Aichi targets, governments must translate them into appropriate national targets, develop a strategy (i.e. the NBSAPs) to meet them, communicate this strategy and coordinate actions to meeting strategy objectives via collaboration across departments and sectors. Yet, we have found that numerous barriers impede this process; from lack of nationally coordinated research and conservation objectives to low staff capacity and unsuccessful local and international collaborations.

Going forward, these implementation issues need to be addressed to meet future targets (Phang et al., 2020). How this can best be done is an urgent topic and requires a systems change approach (Chan et al., 2020; Obura et al., 2021; Phang et al., 2020; Rice et al., 2020), but we argue that a first step should be a structured consultation with those tasked with developing and implementing NBSAPs to understand exactly what is lacking/needed on a case-by-case basis coupled with targeted international funding to assist island nations in strengthening this process. Stronger national coordination of efforts, once achieved, will have a positive knock-on effect to many of the barriers to collaboration that practitioners have experienced.

4.2 | Collaboration

Collaboration is the glue that strengthens and pulls together individual efforts required to achieve national biodiversity targets. Whether between or across government, the private sector, NGO's or academic institutions, the aim of collaborations is to achieve common objectives, solve problems, share resources and expertise, exchange knowledge and utilise skill sets. This requires strong central coordination to bring a variety of voices to the table and ensure information flows freely. Our results show that half of our respondents experienced a lack of national research coordination and that one of the major barriers to collaboration is lack of coordination by governments. Often practitioners/organisations are working to manage one or more sites—in this study over half of practitioners work with one organisation to manage specific areas—and within a country there could be hundreds of practitioners working to achieve similar objectives (e.g. 67% of practitioners in our survey shared the management objective of restoring native habitat). Without working groups that include government officials and practitioners, efforts are isolated and may not align or translate into national objectives.

Ideally, governments would create platforms for each target sector (e.g. fisheries, coral reefs, native forests etc) bringing all relevant practitioners together, to ensure individual site management objectives link to national objectives. This also requires that progress towards achieving these targets is regularly assessed and reported, not only for the sake of fulfilling national obligations under various conventions but also to develop a meaningful adaptive management cycle that informs, ensures feedback and requires action from government and practitioners. This should also include the use of programmes and user-friendly formats that are specifically designed to measure the success/failure of actions. In addition, such platforms would create an environment to stimulate knowledge and

skill exchange and create a sense of joint endeavour, where the goals are clear and where the contribution of each actor is transparent and measurable. Such forums could also identify gaps in knowledge and action, which could highlight priority research and action areas to be promoted via regional funding bodies. How to establish this 'ideal' vision, however, is less clear, especially if governments with already stretched resources and human capacity, have little attention to direct to coordinating these efforts. In some instances, NGOs have stepped in to facilitate these forums and this has led to more collaboration and streamlining of efforts (Burt et al., 2021). With this in mind we suggest that funders should consider including the creation of forums for open data and knowledge sharing under their project calls. This suggestion goes hand-in-hand with the need for longer project funding cycles, which was the solution with the highest support from respondents.

Of other barriers that prevent effective collaboration, the most common in a local context was egos and interpersonal issues (84%). This issue has had very little coverage and yet appears to play a major part in preventing effective local collaboration. Our results suggest that our inability to put aside egos and overcome interpersonal issues hinders conservation efforts world-wide. The scoping interviews with practitioners highlighted the kind of effects that unrestrained egos may create, such as the blocking of data-sharing agreements and unwillingness to support or participate in knowledge or skill exchange activities, but did not suggest potential solutions (Burt et al., 2021). Overall, solutions to this barrier are less tangible than for others but, as with all problem-solving, the first step is to define the problem and raise awareness of the issue. Doing so will potentially promote a culture where such issues are less accepted and more readily 'called out' and this could assist practitioners who feel that they have: *'no power to prevent/mitigate bad behaviour, especially by senior/permanent staff'*.

4.3 | Human capacity

Capacity issues are a well-documented barrier to effective management (Gill et al., 2017; Gustafsson et al., 2020; Keppel et al., 2014; Lee & Jetz, 2008), but the extent to which they hinder progress and the specific type of capacity lacking has been unclear. In our survey, low staff capacity was the most frequently experienced barrier (85%) of those listed (except sections specific to barriers to 'collaboration' and 'turning data into useful information'). Specifically, capacity limitations in data analysis were considered a major barrier to turning data into useful information for management. As such, when practitioners were asked to choose the skills missing from their organisation that would greatly enhance their management effectiveness, the most commonly listed were data analysis, data management and leadership skills. The former two skills are clearly vital for successful evidenced-based conservation management, while the latter is essential for much of the coordination and communication needed to improve management, as this quote from one respondent makes clear: *'The main factor constraining effective*

management in organisations in ca. 15 countries / overseas territories / have worked with is leadership capacity (effectiveness of boards, quality of leadership, suitability of directors). Everything else is influenced by this and intervention, to be effective, must be at the organisational / constitutional management level to facilitate change'.

The proposed solutions listed in the survey were based upon suggestions by practitioners in the scoping interviews (Burt et al., 2021) and it is not surprising that the solutions with the most support from practitioners were those aimed at enhancing human capacity. These findings underline the need to invest in developing the skills that will most enhance management effectiveness. Such skills may not necessarily be gained through current academic training options, even within comparatively well-resourced nations, but even less so in SIDS (132 of our respondents were based in SIDS). According to this SIDS practitioner: *'What would most benefit our work and goals is a higher level of education and training of local staff. The available in-country training is not sufficient for the level required for effective and independent conservation work on data collection, analysis and reporting. Organisations depend on foreign nationals to do this type of work and it is very difficult to train local staff without this basic level of education and understanding'.*

Clearly building the right type of capacity for improving effective management of island ecosystems is complex and requires a combination of technical and soft skills, delivered in a way that ensures uptake, and is available to all in perpetuity. The mismatch between the skills that are taught to students and the skills required in biodiversity conservation and management positions (Blickley et al., 2013; Bonine et al., 2003; Lucas et al., 2017; Muir & Schwartz, 2009) has led to the development of a handful of conservation leadership courses that aim to cover both technical and soft skills (e.g. Sandbrook et al., 2021). While these courses have a very positive impact, their overall effect is confined due to their operational scale or attendance costs (in addition to their location in only a few countries). Our survey clearly shows a consensus among island ecosystem management practitioners as to which skills would most enhance their efforts. Investment into developing specific modules which incorporate such skills into tertiary education—or as stand-alone courses (online or in-person)—could greatly enhance biodiversity management effectiveness, especially on islands where staff struggle to afford and access specific courses. Implementing this 'solution' admittedly requires funds to be made available. However, our aim is to bring attention to these issues by quantifying them and using these results to demonstrate that meeting objectives at local and ultimately national scales will require more equitable funding to those places at the frontline of biodiversity loss. To enable more transformative change will require long-term financial support to strengthen national capacity, both human and institutional, not simply through funding more projects for conservation actions or research. This inherent inequity is summarised in this comment from a SIDS practitioner: *'We do not have any universities and so all tertiary and higher-level education must be carried out overseas...this often results in brain-drain as employment opportunities are better, and better-compensated, in this field elsewhere'.*

The requirement to 'build capacity' is now common in project funding calls, but the resulting efforts may not be greatly effective in developing the capacity that is required, as one respondent explained: *'Skill transfer between academic researchers and staff is commonly requested but is not effective in the long-term as it provides only very specific training, often only an hour or two, or a single workshop, and while it can be a useful skill, it doesn't address the major capacity gaps'.* To ensure that capacity building efforts are meaningful and not just a box-ticking exercise (Harden-Davies et al., 2022), we suggest that, from the outset, project funders or institutions that collaborate with local organisations *ask practitioners* how they can best support the bridging of capacity gaps, for example by budgeting for local masters/PhD students within the project.

4.4 | Turning data into useful information for management

Alongside capacity issues, the barriers to turning data into useful information for management were highly prevalent; for example, 61% of practitioners were unclear about why they were collecting certain data (always or sometimes), with 67% reporting either unclear monitoring aims or that monitoring programmes do not link clearly with management objectives, something that was probably exacerbated by a lack of standardised protocols (77% always or sometimes). These components are fundamental to successful monitoring programmes, yet our results show that these basic building blocks are too often not in place, or are poorly understood by staff. These issues undermine monitoring efforts and outcomes, making it difficult to gain meaningful insights from the data collected and wasting already limited resources (McCarthy et al., 2012). If our results are a benchmark for monitoring standards world-wide, it is perhaps easy to explain the seemingly paradoxical result that recovery plans for threatened species with higher budgets allocated for research and monitoring have relatively poor recovery outcomes (Buxton et al., 2020). The investments made in data collection need to be considered wisely and ensure there are returns, to avoid wasting resources.

Despite these issues, effective monitoring programmes are vital components of biodiversity conservation and there is now a wealth of literature providing guidance on how to improve them, from conceptual design (Field et al., 2007; Lindenmayer et al., 2012; Lindenmayer & Likens, 2010; Reynolds et al., 2016; Salafsky et al., 2002), to deciding what to monitor (Regan et al., 2008; Szabo et al., 2012), and how to implement adaptive monitoring (Lindenmayer & Likens, 2009). While useful, however, these guidelines are not necessarily specific or accessible enough for conservation practitioners, especially considering that many practitioners do not have access to literature (45% of practitioners in our survey) or struggle to find time to search and read literature (62%), let alone understand and apply it (36%; similar to Pullin & Knight, 2005). Bridging these issues will therefore require actions outside site/project and organisation level. Training on the design of monitoring programmes and how they can be linked to and inform management objectives and actions should

be a standard module of conservation courses and yet monitoring design is conspicuous by its absence from these (e.g. Gardner, 2021; Sandbrook et al., 2021; Van Heezik & Seddon, 2005). Such courses, which are mostly designed by academics, could benefit from codevelopment with practitioners or draw from research such as ours to ensure that they more closely align with on the ground capacity needs outside the academic setting.

One of the most concerning results from the online survey was that nearly one-quarter (23%) of practitioners had experienced staff falsifying data. This result is not new (Fanelli, 2009). In one example a practitioner described how: *'staff fabricated the sightings of individuals belonging to [an endangered bird population], when these individuals were already known to be deceased, consequently this data was used to down-list the species from 'endangered' to 'vulnerable' on the IUCN Red List'*. Given the extent of this problem, this needs to be considered and addressed and this can only really be done at site or project level. For example, by developing specific strategies to identify and prevent this malpractice such as double or triple data checking, additional training, close supervision of monitoring staff and regular review of data. Ultimately, the responsibility for data quality lies with the management or leadership of the project or organisation to ensure staff understand why data are collected, the implications of data falsification and are sufficiently motivated in their roles to avoid it. Staff morale is also tied to this type of issue: *'Most field staff in my organisation do this work because they are passionate about it, but this passion quickly turns to cynicism and jadedness if they feel that the actual on-the-ground work isn't prioritised as it should be and senior leadership make decisions that are not in the best interests of conservation'*.

5 | CONCLUSION

The practitioners who manage island ecosystems may not necessarily be thinking beyond their site- or species-level objectives, but collectively their work can have profoundly positive impacts on species, sites and conservation progress world-wide and contribute to meeting national biodiversity targets. By undertaking an international study that directly engages with practitioners working at the front-line of island ecosystem management, we have categorically shown that most practitioners, regardless of the country they are working in, encounter multiple barriers that impact their ability to achieve effective management of island ecosystems world-wide. The practitioners in this study have shown us in no uncertain terms what it is they need to enhance this effectiveness.

Despite the undisputed need for truly transformative change (Chan et al., 2020) to address the underlying causes of many of these barriers, more immediate and direct investment in strengthening the people and systems that are at the frontline of preventing biodiversity loss on islands is needed. Specifically, funding should be prioritised towards SIDS, to mobilise SIDS-developed training initiatives that build human and institutional capacity and to promote initiatives that drive more strategic and collaborative efforts to meet objectives. Information generated from this and other studies that

directly voice practitioner needs could be used to leverage funding towards targeted actions to bridge these barriers, enhancing the effectiveness of island ecosystem management and increasing our chance of meeting biodiversity targets, whether local, national or global.

AUTHOR CONTRIBUTIONS

April Burt and Nancy Bunbury conceived the study. April Burt, Ana Nuno and Nancy Bunbury developed the methodology. April Burt analysed the data under guidance of Ana Nuno, prepared the figures and tables and wrote the first draft of the manuscript. April Burt, Lindsay A Turnbull, Frauke Fleischer-Dogley, Nancy Bunbury, and Ana Nuno contributed substantially to refining further drafts of the manuscript.

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CONFLICT OF INTEREST

The authors have no conflict of interest in relation to this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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