PARKS

The International Journal of Protected Areas and Conservation

Developing capacity for a protected planet

Issue 26.2 November 2020

IUCN WCPA World Commission on Protected Areas   Convention on Biological Diversity   protected planet

IUCN PROTECTED AREA DEFINITION, MANAGEMENT CATEGORIES AND GOVERNANCE TYPES

IUCN defines a protected area as:

A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

The definition is expanded by six management categories (one with a sub-division), summarized below.

Ia Strict nature reserve: Strictly protected for biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are controlled and limited to ensure protection of the conservation values.

Ib Wilderness area: Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, protected and managed to preserve their natural condition.

II National park: Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems, which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.

III Natural monument or feature: Areas set aside to protect a specific natural monument, which can be a landform, sea mount, marine cavern, geological feature such as a cave, or a living feature such as an ancient grove.

IV Habitat/species management area: Areas to protect particular species or habitats, where management reflects this priority. Many will need regular, active interventions to meet the needs of particular species or habitats, but this is not a requirement of the category.

V Protected landscape or seascape: Where the interaction of people and nature over time has produced a distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

VI Protected areas with sustainable use of natural resources: Areas which conserve ecosystems, together with associated cultural values and traditional natural resource management systems. Generally large, mainly in a natural condition, with a proportion under sustainable natural resource management and where low-level non-industrial natural resource use compatible with nature conservation is seen as one of the main aims.

The category should be based around the primary management objective(s), which should apply to at least three-quarters of the protected area – the 75 per cent rule.

The management categories are applied with a typology of governance types – a description of who holds authority and responsibility for the protected area.

IUCN defines four governance types.

Governance by government: Federal or national ministry/ agency in charge; sub-national ministry/agency in charge; government-delegated management (e.g. to NGO)

Shared governance: Collaborative management (various degrees of influence); joint management (pluralist management board; transboundary management (various levels across international borders)

Private governance: By individual owner; by non-profit organisations (NGOs, universities, cooperatives); by for-profit organsations (individuals or corporate)

Governance by indigenous peoples and local communities: Indigenous peoples' conserved areas and territories; community conserved areas – declared and run by local communities

For more information on the IUCN definition, categories and governance type see the 2008 *Guidelines for applying protected area management categories* which can be downloaded at: www.iucn.org/pa_categories

IUCN WCPA'S BEST PRACTICE PROTECTED AREA GUIDELINES SERIES

IUCN-WCPA's Best Practice Protected Area Guidelines are the world's authoritative resource for protected area managers. Involving collaboration among specialist practitioners dedicated to supporting better implementation in the field, they distil learning and advice drawn from across IUCN. Applied in the field, they are building institutional and individual capacity to manage protected area systems effectively, equitably and sustainably, and to cope with the myriad of challenges faced in practice. They also assist national governments, protected area agencies, nongovernmental organisations, communities and private sector partners to meet their commitments and goals, and especially the Convention on Biological Diversity's Programme of Work on Protected Areas.

A full set of guidelines is available at: www.iucn.org/pa_guidelines
Complementary resources are available at: www.cbd.int/protected/tools/
Contribute to developing capacity for a Protected Planet at: www.protectedplanet.net/

PARKS is published electronically twice a year by IUCN's World Commission on Protected Areas. For more information see: www.parksjournal.com

PARKS is published to strengthen international collaboration in protected area development and management by:

- exchanging information on practical management issues, especially learning from case studies of applied ideas;
- serving as a global forum for discussing new and emerging issues that relate to protected areas;
- promoting understanding of the values and benefits derived from protected areas to communities, visitors, business and others;
- ensuring that protected areas fulfill their primary role in nature conservation while addressing critical issues such as ecologically sustainable development, social justice and climate change adaptation and mitigation;
- changing and improving protected area support and behaviour through use of information provided in the journal; and
- publishing scientific research relevant to IUCN's work on protected areas.

Thanks to: Mariart for layout advice and front cover picture production. Patricia Odio Yglesias and Sarah LaBrasca for abstract translations. Caroline Snow for proofreading. And to all the reviewers who so diligently helped in the production of this issue.

Published by: IUCN, Gland, Switzerland

Citation: IUCN WCPA (2020). *PARKS. The International Journal of Protected Areas and Conservation,* Volume 26.2, Gland, Switzerland: IUCN.

ISSN: ISSN 2411-2119 (Online), ISSN 0960-233X (Print)

DOI: 10.2305/IUCN.CH.2020PARKS-26-2en

Cover photo: Quartzite crags of the Eastern Arthur Range, Tasmanian Wilderness World Heritage Area, Australia © Martin Hawes

Editing: Marc Hockings, Helen Newing , Bas Verschuuren, Olivier Chassot, Pamela Wright, Jonas Geldmann

Layout by: Marc Hockings, IUCN WCPA

Available from: IUCN (International Union for Conservation of Nature)
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parksjournal.com
iucn.org/theme/protected-areas/publications/parks-journal

PARKS: THE INTERNATIONAL JOURNAL OF PROTECTED AREAS AND CONSERVATION

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CONTENTS

EDITORIAL

Marc Hockings, Managing Editor

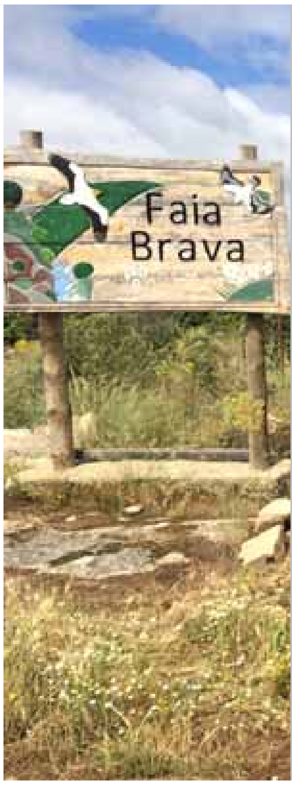
It has certainly been a year like no other. I am sure that many of the readers of this issue will have spent more time "zooming" than they could ever have imagined and much less time in aeroplanes on their way to meetings in far-flung places. Let us hope that we can agree on new global conservation goals and targets next year and perhaps make 2021 the year of progress for nature conservation that we had planned for this current 12 months.

One job completed while we have been spending time at home was to apply for registration of the journal with the Directory of Open Access Journals (DOAJ). In this era of predatory publishers, it is important that authors and readers can be confident of the journals that they publish in and read. DOAJ provides a recognised database of high quality, open access, peer-reviewed journals. Some university libraries will not provide links to open access journals in their catalogues unless the journals are included in the DOAJ list. As they explain on their website "DOAJ's mission is to increase the visibility, accessibility, reputation, usage and impact of quality, peer-reviewed, open access scholarly research journals globally, regardless of discipline, geography or language. DOAJ will work with editors, publishers and journal owners to help them understand the value of best practice publishing and standards and apply those to their own operations" (https://doaj.org/about). Going through the DOAJ criteria in order to apply for listing in the Directory, helped us improve aspects of journal management such as copyright and information on journal policies. I was very pleased to hear in September that PARKS had been accepted for inclusion in the Directory.

While many of us have been staying at or close to home during the pandemic, many have clearly been writing. This issue contains 11 papers and we have a record number of submissions for the coming issues. This success of course increases competition for the limited space in the journal but we will continue to prioritise diversity as well as quality in the papers that are accepted. Authors in this current issue come from 23 countries.

Papers in this issue also reflect diversity. They include papers on conceptual issues in conservation (wilderness definition, niche tourism, human-wildlife conflict and climate change, a framework for area-based conservation, and institutional arrangements for privately protected areas); lessons learned in practical conservation monitoring and management (species re-introduction, establishing national biodiversity monitoring programs, and tourism impact monitoring) , as well as papers on cultural ecosystem service assessment, management of tiger reserves and changes in support for protected areas in Brazil.

Joint editors Adrian Phillips and Brent Mitchell are currently pulling together a special issue of PARKS planned for publication early in 2021, which will be focused on one, huge topic: COVID-19 and what it means for the world's protected areas. They have commissioned eleven peer reviewed articles. These give a historical perspective and examine the drivers behind the pandemic; consider its impact in different parts of the world and on different groups and sectors; and look forward to how we might put protected and conserved areas at the heart of a post-COVID recovery. Each of these articles has been authored by a leading expert or experts in the field, supported by a total of approximately 170 co-authors from around the world – truly a global synthesis of our current state of knowledge. In addition, the issue will contain ten short essays by international figures on what lessons humanity needs to learn from this unprecedented experience. The issue will be introduced with a piece by the incoming CEO of the GEF, Carlos Manuel Rodríguez, and closed with the thoughts of the new Director General of IUCN, Bruno Oberle. The coming year will involve critical meetings of IUCN, the CBD and the Climate Change Convention: all will have to draw up their plans in a post-COVID world. We hope this special issue of PARKS will not only be of wide interest to our regular readers but also inform and enrich these critical international discussions.



TOWARDS A MULTIDIMENSIONAL FRAMEWORK TO ASSESS THE SOCIAL AND ECOLOGICAL FIT OF INSTITUTIONAL ARRANGEMENTS FOR PRIVATE PROTECTED AREAS

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ABSTRACT
Private protected areas (PPAs) are considered a promising governance conservation tool to complement public-run protected areas. Despite their promotion in national and international environmental agendas and increased adoption worldwide, there has been little research on the overarching implications of their implementation. This paper introduces a framework to explore the suitability of the institutional arrangements of PPAs to enhance nature conservation whilst meeting societal needs. To do so, we draw on the literature on socio-ecological systems incorporating insights from critical perspectives on agency and power. The resulting conceptual approach pinpoints the interplays between the ecological and social systems, providing a systemic perspective which underpins an interdisciplinary diagnostic framework. This draws on the concepts of social and ecological fit and integrates contributions from the literature on good governance; fine-tuning good governance principles to suit PPAs. We outline a multi-tiered tool for assessing PPAs. This is a first step to comprehensively addressing the match of PPAs' institutional models with the ecological and social dimensions of complex systems.

Key words: private protected areas, nature conservation, social fit, ecological fit, socio-ecological system

INTRODUCTION
Protected areas are central strategies in global endeavours aiming to conserve the biodiversity of our planet. In order to strengthen and extend protected area networks, nature conservation actions carried out by private landowners are increasingly common and actively promoted by international organisations (IUCN, 2016). Indeed, Private Protected Areas (PPAs), defined as sites under voluntary long-term conservation, owned and managed by private actors, are considered a promising complement to public-run protected areas (Kamal et al., 2014). PPAs are expected to reduce the burden on state actors, mobilise new sectors of society (Holmes, 2012) and leverage private actors' resources. Their voluntary nature is expected to reduce conservation-induced displacements and restrictions on the use of natural resources suffered by local communities in public protected sites (Langholz & Lassoie, 2001).

With their origins in hunting reserves, PPAs have proliferated rapidly over recent decades (Bingham et al., 2017) due to connected factors such as the growing acceptance of the neoliberal conservation narrative (Büscher & Whande, 2012), the rise of conservation NGOs and incentives resulting from the statutory recognition of PPAs (ELI, 2003). Nowadays, PPAs are mostly found in the United States, Australia, Canada, some Latin American countries and South Africa (Stolton et al., 2014), in a variety of institutional arrangements based on private legal tools or public law[1] (ELI, 2003).

The Faia Brava reserve, the first Private Protected Area in Portugal © Giulia Iannuzzi

The increase in PPAs worldwide has sparked multiple studies focusing, for example, on 'public versus private' governance, concerns about state rollback (Büscher & Whande, 2007; Drescher & Brenner, 2018) and landowners' motivations (Selinske et al., 2015). A recent study has assessed the conservation impacts of PPAs, analysing land cover changes (Nolte et al., 2019). Nevertheless, little attention has been paid to the combination of social and ecological implications of the implementation of PPAs (Slovak, 2017).

This paper proposes a framework to explore the suitability of PPAs' institutional settings to enhance nature conservation whilst meeting societal needs. We define institutional settings (hereinafter also referred to as institutional arrangements or models) as the formal institutions that structure social interactions (see North, 1991) and influence human–nature relationships. In the case of PPAs, these correspond to the rules established in law (e.g. law regulating the statutory recognition of PPAs), including the property rights regime, as well as the specific norms defined in contracts (e.g. contracts between public actors and the private actor managing the PPA).

Conceptually, we build on the literature on Socio-Ecological Systems (SES), incorporating insights from critical perspectives in social sciences regarding exploration into human agency and the understanding of power dynamics, to pinpoint the interplays between ecological and social systems.

This approach informs the interdisciplinary diagnostic framework in the second part of the paper, which draws on the concepts of social and ecological institutional fit, 'translated' into assessment criteria based on good governance principles and adapted for PPAs.

Our goal is to propose multiple assessment criteria to provide insights into the suitability of institutional arrangements for PPAs, informed by ecological and social dimensions and SES dynamics, in order to inform the design of more effective and fit-for-purpose institutions. Good governance principles are here used as normative guidance for addressing the alignment of institutions with the social context, building on a growing body of literature (Turner et al., 2018; Turner et al., 2014). Governance, as it is understood here, is about the interactions of actors, power, processes and the way decisions are made and implemented (Graham et al., 2003), in both formal and informal institutions. Formal institutional arrangements influence governance quality, which is both a goal in its own right and crucial for successful nature conservation (Eklund & Cabeza, 2017).

Acknowledging the diversity of institutional models for PPAs, we pay special attention to those whose establishment and/or management involve actions by public actors (e.g. in monitoring actions, providing incentives), that is, PPAs resembling public–private partnerships.

SOCIO-ECOLOGICAL SYSTEMS FRAMEWORKS

Socio-Ecological Systems (SESs) are complex systems that are constantly changing due to interactions between actors, institutions and ecological dynamics taking place across temporal and spatial scales and shaped by social-ecological settings (Berkes & Folke, 1998; Ostrom, 2009). Driven by the urgency to address complex environmental issues, several interdisciplinary research frameworks have been proposed in recent decades. They are distinguished by their theoretical backgrounds, the scales they address and the distinct conceptualisations of social and ecological sub-systems (Binder et al., 2013). Notwithstanding, there are conceptual commonalities:

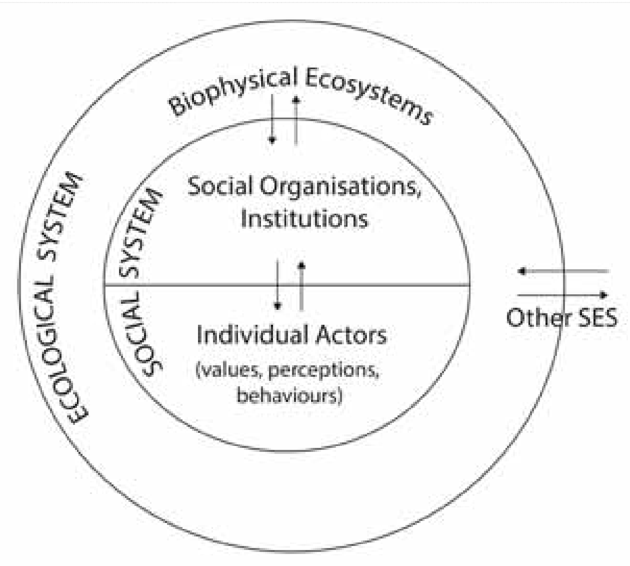

Figure 1. Socio-ecological system: a conceptual framework

a. SESs are coupled systems with ecological and social components that reciprocally interact. Each component encompasses numerous dimensions on different scales (e.g. temporal, spatial and jurisdictional).

b. SESs are open systems, embedded in broader socioeconomic, political and ecological settings. Each SES interacts with, and is nested in, other SESs.

c. SESs are complex and dynamic systems. They have broader and narrower scale interactions and the macro-level pattern is not inferred from the behaviour of their components. In particular, numerous system dynamics are characterised by non-linearity that hinders the ability to predict how SESs respond to change.

Political ecologists, anthropologists and other social scientists have highlighted the pitfalls of some SES frameworks, emphasising the importance of a critical understanding. In particular, they argue that a strong emphasis on the influence of the environment on human behaviour and livelihoods may overshadow the role of social institutions, cultural context and power (Fabinyi et al., 2014; Singleton, 2017). Another critique focuses on the epistemological drawback of implying that governance arrangements are rationally designed in order to solve ecological problems. Studies have revealed that many traditional practices have emerged not from conservation goals, but as a consequence of socio-political and cultural conditions. To exemplify, sacred forests, now labelled as indigenous protected areas, were established as places of cultural memory (Chouin, 2002). Furthermore, macro-level perspectives usually downplay differences of interests, power and expectations among social groups and single individuals (Fabinyi et al., 2014). A more refined analysis incorporating power conceptions (e.g. discursive and institutional forms of power) is expected to advance knowledge on the evolution of SESs, disentangling dynamics and contradictions (Coulthard, 2012; Clement, 2013).

Examining SESs from a critical perspective standpoint, we introduce our conceptual framework (Figure 1). It embraces the human-in-nature perspective, conceptualising human systems as an integral part of the biophysical world. We do not mean to give a full representation of the SES's function, rather an illustration of the main interactions among and within its components.

The social system is understood as multi-scale patterns of interactions between actors and organisations

influenced by issues of power (Galaz et al., 2008). The agency of individuals is acknowledged, in complex coevolution with social structures. That is, human agency and social structures are considered mutually constitutive.
In the ecological (sub)system, changes in one component could potentially impact the SES at a higher level. However, the interactions through which this subsystem evolves should be viewed differently in comparison to social systems, in which humans can exercise intentional conscious choice (Farrell, 2007).

Finally, the link between the social and the ecological subsystems is characterised by mutual feedback. All the non-human environment has to some degree been shaped by human activity, however it does not remain passive; it also shapes human actions and relations in a feedback loop. A growing body of studies examines the link between nature conservation and socio-economic development exploring, for example, the relationship between human displacements and land use changes (Miller et al., 2012), and the impact of conservation initiatives on the behaviour of actors (Hurst et al., 2013).

DESIGNING FIT-FOR-PURPOSE INSTITUTIONS TOWARDS A MULTI-CRITERIA FRAMEWORK TO ASSESS THE INSTITUTIONAL ARRANGEMENTS OF PPAS

Unpacking the complexity of institutional fit

The mainstreaming of SES approaches in conservation policies and practices is gaining momentum thanks to the growing literature on institutional fit – the match of institutions (defined as formal and informal rules[2]) with the socio-ecological problems they are meant to address, across temporal and spatial scales and institutional levels (Folke et al., 2007). Greater fit is expected to enhance institutional performance (Epstein et al., 2015). This concept is, thus, of central importance for exploring to what extent nature conservation institutions are effective, that is to say, fit-for-purpose (Clement et al., 2016).

Institutional fit is referred to and used with multiple interpretations. Epstein et al. (2015) distinguish three general types of fit in the environmental governance literature: ecological fit, social fit and socio-ecological fit (Table 1).

Table 1. Types of institutional fit

Type of fit	Dimensions	Evaluation of institutional match	Examples
Ecological fit	Spatial dimension	Alignment between the territorial scope of the institution and the geographical extent of the ecological issue	Fishing regulation beyond national boundaries
	Temporal dimension	Match of the institution with the progress of the ecological process/issue	Slow regulatory responses as temporal misfit
	Functional dimension	Management considering the linkages among the constituents of ecological systems	Practices for synchronous recovery of predator and prey
Social fit	Institutional acceptance	Social acceptability of rulemaking arrangements given people's expectations and psychological needs	Inclusive decision-making process that reinforces a sense of procedural justice enhancing social acceptability
	Interplay with values and social customs	Alignment of the institution with existing norms and values	Institutions for wildlife management able to support local social practices
	Interaction with scales of social organisation	Horizontal and vertical coordination of institutions across space and levels of social organisations	Cross-scale interplays of institutions for coordination and knowledge sharing
Socio-ecological fit	Institutions designed for coupled social and ecological systems	Match of institutional design with social and ecological circumstances in local contexts, associated with a desirable outcome	Higher performance of third-party monitoring of forest commons in intermediate-sized groups

Ecological fit is concerned with the alignment of the institution with the spatial, temporal and functional characteristics of ecosystem issues. In the polycentric and multilevel governance literature, social fit has largely been discussed in the context of governance failures.

Socio-ecological system fit proceeds from the acknowledgement that neither ecological fit nor social fit alone is sufficient to give us a comprehensive account of institutional performance as they each focus on just one component of a complex system. SES fit tackles more overarching questions: how can institutions be designed so that humans and nature can successfully coexist? How can we ensure an emphasis on the dynamic interplays of the components of SESs? To address these questions, researchers have explored how contextual attributes affect institutional performance. Hence, empirical studies have focused on combining data on the social and ecological outcomes of an institution, to understand under what conditions it is able to generate a desirable performance (Epstein et al., 2015). The ultimate aim is to properly inform the design of institutional arrangements for the unique combination of circumstances in local contexts.

From a critical standpoint, examining the ecological or social domain (or a single part of either) in isolation is insufficient and misleading. Likewise, the inclination to disentangle variables that interact at different scales in SESs and isolate causal relationships, makes SESs' fit an "intractable analytical problem" (Epstein et al., 2015: 37). Finally, defining, from a holistic socio-ecological standpoint, a common overriding goal (e.g. the sustainable use of resources; the system's resilience) may come at the expense of other criteria within nature conservation policies. In this case, the SES fit approach may fall short of addressing power issues.

We propose to reconcile ecological, social and socio-ecological system fit, combining their potentialities and attempting to avoid their pitfalls. To tackle the above-mentioned issues, we combined the three dimensions within the ecological fit approach (i. ecological, ii. temporal and iii. functional) with the three dimensions of social fit (i. institutional acceptance, ii. interplays with values and social customs and iii. match with scales of social organisation). Our aim is to integrate the evaluation of both the ecological and social fit of PPAs' institutional arrangements, without losing the holistic perspective given by the systemic conceptual framework of SESs presented above (Figure 2).

Additionally, based on the literature on good governance principles for protected areas, the six dimensions are 'translated' into assessment criteria adapted for the features of PPAs.

Good governance principles as measures of social fit

In the field of nature conservation policies, the shift from hierarchical to alternative approaches seeking the involvement of the private sector, local authorities and local communities has given rise to a debate on the suitability of new governance models.

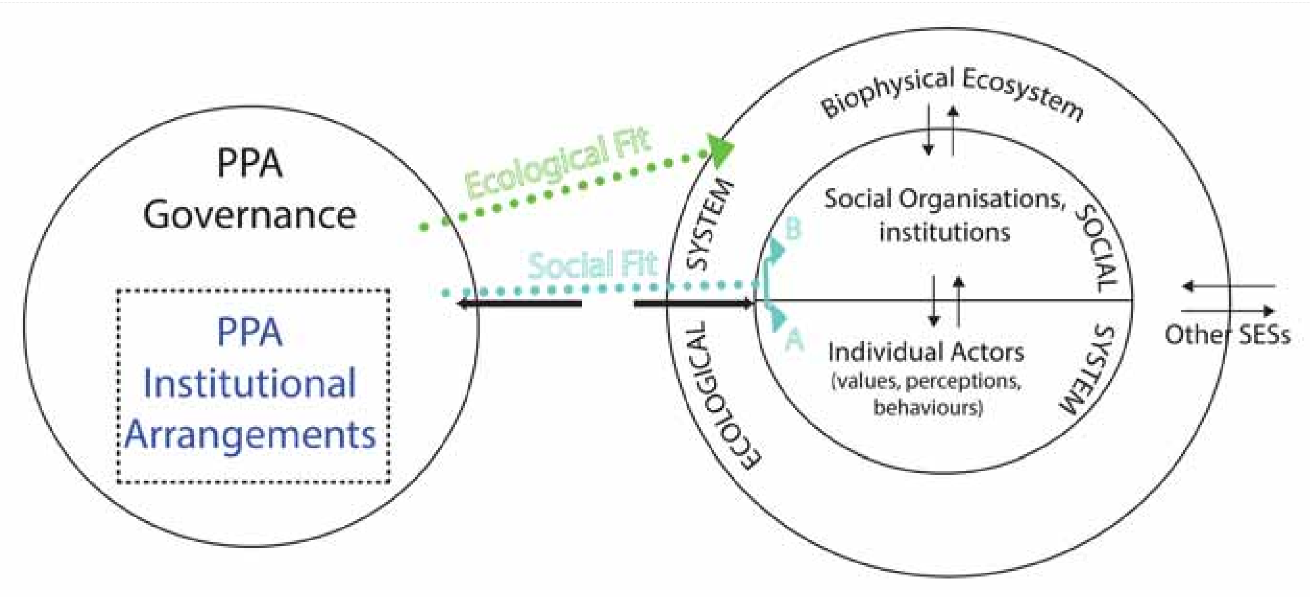

Figure 2. The assessment of ecological and social fit of PPAs

As briefly referred to above, we understand governance as a set of processes, resources, institutions and actors that determine how decisions are made and implemented (Graham et al., 2003); thus, encompassing informal rules and formal institutional arrangements. Whereas, in its prescriptive connotation, governance, specifically 'good governance', is about securing the collective interest, since it represents the embodiment of democratic and participatory traditions, grounded in human rights principles.

In particular, Graham et al. (2003) suggested a set of good governance principles based on those expressed by the UNDP (1997): (i) legitimacy and voice, (ii) direction, (iii) performance, (iv) accountability and (v) fairness. Conceptual and evaluation frameworks, based on minor variations of these principles, to assess the quality of the governance of protected areas have been successively proposed (Table 2).

While management effectiveness evaluation is a well-established practice, the assessment of governance quality is comparatively recent and does not yet offer a robust body of knowledge for the peculiarities of PPAs. We seek to fill this gap. Bridging the literature on good governance principles for protected areas with the literature on PPAs, we tailor each principle to the characteristics of PPAs, particularly those resembling public–private partnerships (involving state actions).
To outline good governance principles, their multiple facets and connections, we draw on Lockwood (2010), whose innovative work in this field first adopted 'connectivity' and 'resilience' and removed 'performance' as key governance principles[3].

Legitimacy refers to the acceptance of the governing authority exercised by a public or private actor and the perceptions of the integrity and responsibility with which it exerts power (Graham et al., 2003; Lockwood, 2010). We must however distinguish between input and output legitimacy.

Input legitimacy is conferred by democratic mandate and the processes through which institutions and governing actors are legitimised. For PPAs, land ownership and resources rights are generally legitimised through their recognition under national or sub-national law. However, customary laws and practices are still relevant in countries where legal recognition of tenure rights is not in place (Stolton et al., 2014). The legitimacy of PPAs' institutional settings, as public–private partnerships, is thus usually conferred by legal tools, such as contracts and protocols (ELI, 2003).

Output legitimacy reflects effectiveness and responsiveness; thus, it deals with problem-solving logics. Constructivist scholars highlight the relevance of the communicative ability of governing actors to build consensus (Schmidt, 2013). The output legitimacy of PPAs relates to institutional outputs and the capacity of the area manager to earn community support through performance success (e.g. the fulfilment of conservation objectives).

Finally, throughput legitimacy mirrors the inclusiveness of governance processes, and other procedural principles presented below. Participatory processes and communication between managers of protected areas and local communities have been found to enhance the perceived legitimacy of protected areas (Stern, 2008).

Table 2. Good governance principles for protected areas

Graham et al. (2003)	Abrams et al. (2003)	Hannah (2006)	Lockwood (2010)
Legitimacy and voice	Legitimacy and voice	Legitimacy	Legitimacy
Direction	Direction	Direction	Transparency
Performance	Performance	Performance	Inclusiveness
Accountability	Accountability	Accountability	Accountability
Fairness	Fairness	Fairness	Fairness
			Connectivity
			Resilience

Transparency refers to i) the availability of relevant and accurate information and its accessibility; ii) the visibility and clarity of policymaking processes. It is increasingly recommended that policymaking follows a transparent process grounded in citizens' and stakeholders' right to know about matters that affect them (Lockwood, 2010). Along with information on the actors and the decision-making process, the rationale underpinning a specific course of action and the resulting choices made should be readily available and easily understandable (Graham et al., 2003; Lockwood, 2010).

For PPAs, transparency means the accessibility of relevant information on the institutional settings that define the rights and responsibilities of public and private actors. Likewise, data reporting is also likely to motivate landowners to participate in conservation activities (Clements et al., 2018). The accessibility of performance assessment and monitoring (as in the Finnish Metso Programme[4]) is critical for evaluating whether PPAs continue to fulfil their criteria defined by law as tools for nature conservation. However, it is necessary to strike a balance between burdensome reporting requirements and transparency on PPAs' performance so as not to risk undermining their outcomes (Hannah, 2006). Similarly, transparency on data reporting may raise concerns regarding the risk of poaching or the location of areas with high natural values, making them attractive for property development (Bingham et al., 2017; Clements et al., 2018).

Accountability encompasses the i) clear and agreed allocation of roles and responsibilities among governing entities; ii) the answerability of governing bodies to constituencies (downward accountability) and to higher governance bodies (upward accountability).
People affected by protected areas should know to whom they can report their concerns to resolve issues related to protected areas' establishment and management (Zafra-Calvo et al., 2017). A clear assignment of responsibilities is paramount, as constituents have the right to question, and express approval or disapproval of processes, actions and inactions.

In officially recognised PPAs, a clear definition of roles and responsibilities among landowners, managers and state/public actors as parties of the public–private partnership is considered desirable. Legal contracts and administrative instruments convey accountability especially when landowners enjoy tax benefits (Hannah, 2006). Downward accountability in PPAs is multi-layered, as it concerns both the accountability of NGOs (if owner and/or manager) to their members, and that of public actors to their citizens (Lockwood, 2010).

Inclusiveness refers to the opportunities that actors have to participate and influence decision making. Inclusive public participation is equally about democratising and legitimising the decision-making process and improving its quality and effectiveness by incorporating different views (Stoll-Kleemann, 2010).

According to Silva et al. (2015), participation should occur from the early stages, to avoid a mere validation of decisions, and should promote the engagement of marginalised actors who usually bear the costs of conservation. Inclusiveness can be effectively achieved through diverse formal processes and informal interactions (Armitage et al., 2012).

For PPAs, inclusive governance is necessary to address concerns and resistance from local communities related to conservation grabbing (Ladle et al., 2014), that is the transfer of control over land and resources from local to outside actors for conservation purposes (Holmes, 2014).

To illustrate, a process promoting consultation between the public entity responsible for designating PPAs and the local authorities where the requested PPA is located, as provided by the Portuguese legislations (Iannuzzi et al., 2019), may help to enhance inclusiveness.

Fairness concerns i) the equitable distribution of costs and benefits; ii) the recognition of stakeholders' cultural values, views and identities; iii) the recognition of the intrinsic value of nature. Different criteria for distribution can be applied. For example, the egalitarian criterion requires costs and benefits to be shared equally among stakeholders. Costs and benefits can also be distributed according to needs, privileging the most vulnerable, according to the costs borne or to the efforts made to attain conservation goals (Pascual et al., 2010).

The concept of fairness is dynamically and contextually constructed (Martin et al., 2016). This requires recognition for individual and communitarian notions of social equity and fair compensation (Schokkaert & Devooght, 2003). It is also crucial to acknowledge that issues of unfair resource distribution and material harm are closely linked to questions of cultural misrecognition; these two concerns should be properly addressed in an integrated way (Fraser, 2000; Martin et al., 2016). Consequently, criteria to evaluate the fairness of PPAs deal with the perceptions of winners and losers

Horses in the Faia Brava reserve © Giulia Iannuzzi

and consider both aspects: economic distribution with social and cultural recognition.

In PPAs, land use and access to resources is not controlled from above; the landowner decides to apply restrictions and may voluntarily implement actions for conservation. This is expected to avoid issues related to social justice associated with exclusionary top-down approaches. Nevertheless, the existence of funding or economic incentives for the promotion of PPAs may raise issues of distributional fairness. Moreover, conservation grabbing can be socially harmful once it triggers tensions and local conflicts due to the benefits reaped by outsiders or powerful elites (Fairhead et al., 2012; Holmes, 2014). Conservation may also be a driver for the privatisation of publicly owned resources or common lands and shared resources. It may also cause the consensual yet not fully voluntary sale of land due to economic necessity (Edelman et al., 2013 *apud* Holmes, 2014).

Following the adoption of Aichi target 11 by the Convention on Biological Diversity, which promotes the objective of equitable management for protected areas, a three-dimensional definition of equity has been widely accepted. It encompasses i) procedural equity concerned with how decisions are made, ii) recognition and consideration of social and cultural diversity and of stakeholders' views, and iii) the distributional aspect (Zafra-Calvo et al., 2017). Thus, a parallel can be easily drawn: while the first dimension is linked with the procedural aspects of legitimacy, accountability, transparency and inclusiveness, the second and the third are included in the fairness principle of the proposed framework.

Connectivity encompasses i) connections and coordination between and across all institutional levels, ii) the combination of policy instruments for nature conservation and other public policies (e.g. agriculture and tourism). SESs and landscape approaches to conservation acknowledge the need for connectivity between actors to increase information sharing, trust building and to address shared problems (Brondizio et al., 2009). Indeed, it is widely accepted that each protected area, public-led or private, should not be managed in isolation. Networks of protected sites and transboundary protected areas are examples of cooperation efforts. However, the homogenisation of norms, knowledge and preferences that characterises highly connected contexts, can also be detrimental, e.g. leading to the reduction of actors' explorative ability and adaptive strategies (Bodin & Norberg, 2005). Additionally, the need to design a portfolio of conservation policy options that overcome sectoral approaches is increasingly recognised (see Doremus, 2003).

Consequently, this criterion can be assessed by evaluating both i) the effective inclusion of PPAs in a nature conservation policy portfolio in conjunction with other policy instruments (e.g. inclusion in national and/ or regional strategies) and ii) the coordination of PPAs with other institutions existing in the same area (e.g. spatial plans for the protection of cultural heritage).

Resilience refers to the capacity of a governance system to cope with changes. It is strongly associated with the concept of adaptive governance in resilience scholarship. Adaptive governance is defined as having the capacity to manage complex cross-scale relationships between the social and the ecological, to cope with and adapt to unexpected changes and unpredictable feedback (Folke et al., 2005) and/or to allow a reconfiguration that permits the maintenance of SES functioning.

According to Lockwood (2010), adaptive governance systems for the resilience of protected areas require an institutional design able to i) reconcile institutions that provide long-term security and direction (e.g. legislation) with the flexibility necessary to respond to new dynamics; ii) acknowledge uncertainties related to complex SESs and implement strategic planning in order to reduce risks and guide opportunities; iii) facilitate the assimilation of new knowledge for decision making (e.g. through monitoring and evaluation). Dietz et al. (2003) emphasise the crucial role of inclusive dialogue, supported by formal and informal social networks, for information sharing and improving response diversity. The creation of a formal coordination panel or the promotion of networks between private landowners and other stakeholders (see for example the Finnish Metso Programme) are expected to enhance the resilience of PPAs.

Having outlined the set of good-governance criteria, it is important to note that a growing body of literature has demonstrated that the governance of protected areas affects their effectiveness and, more broadly, social and ecological outcomes (Eklund & Cabeza, 2017). Accordingly, good-governance principles have an ambivalent nature. Firstly, they are considered important per se, as far as they embody ideals of democratic traditions and human rights. As policy instruments for the protection of a common good, PPAs have a particular responsibility going beyond the interest of property rights holders, and concerning the

Workshop for collaborative design of protected areas © Inês Cosme rights of present and future generations (Pieraccini, 2015). Secondly, adherence to good governance principles is also expected to be instrumental to effective outcomes (Dawson et al., 2018). For example, perceptions of inequity may undermine conservation efforts, reducing institutional acceptance and the level of collaboration from local communities (Pascual et al., 2010). Thus, procedural and substantive rationales for the fulfilment of good governance generally overlap with instrumental approaches. Consequently, it has been argued that the perception of good governance principles, such as legitimacy, transparency, accountability and inclusiveness, as well as the match with the principles of connectivity and resilience, may provide an indication of the social fit of governance arrangements (Turner et al., 2018).

Ecological fit

Improving the ecological fit is a key concern of conservation scientists, requiring institutions to align themselves with the spatial, temporal and functional dimensions of the ecological system. Regarding PPAs, the spatial dimension concerns the match of their territorial scope (in terms of location and area covered) with the conservation issues intended to be solved. The size of PPAs is generally smaller than other protected areas (Stolton et al., 2014). Whilst this is not a problem if the PPA is intended to protect a local habitat, concerns may arise in the case of more ambitious management goals, especially if the PPA is not well connected with other protected areas. Do formal institutions promote or hinder a location that improves spatial fit? For example, do they encourage PPAs' connectivity with other protected sites, such as requiring them to be situated on the boundaries of existing public protected areas? (Stolton et al., 2014). Furthermore, it is important to assess whether the criteria for statutory recognition favour PPAs which protect endangered ecosystems and species, or, conversely, a lack of systematic conservation planning makes their location in less threatened environments more likely (Ladle et al., 2014; Margules & Pressey, 2000).

The temporal dimension of ecological fit refers to the match of the governance systems' responses to an environmental problem (Epstein et al., 2015). Slow regulatory responses or the short-term timeframe of decision-makers (due to election cycles) are widely recognised as emblematic examples of temporal misfit; indeed, they lack the rapidity of action and the long timespan required to tackle sustainability issues (Munck af Rosenschöld et al., 2014). Regarding established PPAs, the crucial issue is the length of the protection they provide. According to IUCN guidelines, PPAs "should demonstrate an intent to conservation 'in perpetuity', or at least 'long-term' (a period of at least 25 years)" (Stolton et al., 2014: 10). Consequently, provisions for long-term contract or conservation easements recorded in the title of land, coupled with monitoring actions, are expected to improve temporal fit. Indeed, well designed long-term contracts are intended to make conservation interventions less dependent on electoral cycles. Also, the continuation of the PPA status, or the conservation intent of the private actor, should be ensured in case of changes to ownership (Mitchell et al., 2018).

The functional dimension concerns the suitable management of interlinked constituents of the ecological system (e.g. predators and prey) (Epstein et al., 2015). Monitoring actions to assess progress made in management goals and widely available technical support from public actors may be crucial to enhance the management capacity of private actors. The ecological fit dimension is highly intertwined with the resilience principle. In particular, in order to suitably address the ecological dimensions, private actors should ensure they have scientific and technical capacity, as well as the appropriate resources and motivations to fulfil conservation objectives. Over time, these attributes may lessen due to a reduction in private funding, or may fail to address increasingly demanding management goals while confronting, for example, new ecological threats. Therefore, compliance monitoring and public support for private actors are expected to improve the institutional fit (see e.g. Fitzsimons, 2015).

The diagnostic framework

Table 3 operationalises social fit through good governance principles in order to facilitate their analysis. The principles of legitimacy, transparency, inclusiveness, accountability and fairness are indicators of the dimensions of social fit that deal with institutional acceptance and, more broadly, with stakeholders' values. Connectivity and resilience are instead linked dimensions concerning the fit between institutions and temporal, spatial and jurisdictional scales of social organisations.

The three dimensions of ecological fit (see Table 1) are also integrated into the framework with the aim of providing a multi-tiered interdisciplinary tool.

The growing body of literature on PPAs has allowed us to develop tailored criteria for their assessment, relating

Table 3. The diagnostic framework

		Good Governance Principles	Definitions	Criteria for PPAs' assessment
SOCIAL FIT	Institutional acceptance interplays with stakeholders' values and customs	LEGITIMACY	Acceptance of the authority of an institution to govern *Input legitimacy*: e.g. conferred by the democratic mandate *Output legitimacy*: acquired through effectiveness and responsiveness	Perception of PPAs' institutional arrangements and of public and private actors' input and output legitimacy
		TRANSPARENCY	Availability and accessibility of information. Visibility and clarity of policy-making processes	Satisfaction regarding the availability of contracts, reports and information on policy-making processes
		INCLUSIVENESS	Opportunities to participate in and influence decisions	Perception of opportunities for the effective participation of stakeholders
		ACCOUNTABILITY	Clear and agreed assignment of roles and responsibilities Accountability of governing bodies to constituencies and higher governing bodies	Perception of clear definitions of actors' roles and responsibilities Perception of private actors' accountability to membership and public actors' accountability to citizens
		FAIRNESS	Equitable share of costs and benefits Consideration of social and cultural diversities	Perception of economic distribution (e.g. incentives, land grabbing, changes in local livelihood) and socio-cultural recognition
	Match with scales of social organisation	CONNECTIVITY	Coordination within and between levels of protected area governance Articulation with other policy instruments for conservation and other public policies	PPA connectivity with other protected areas in national and international networks The inclusion of PPA governance and management within e.g. agricultural, tourist policies
		RESILIENCE	Conciliation of long-term security with institutional flexibility to respond to new dynamics Management of threats, opportunities and risks Assimilation of new knowledge	Long-term security of nature protection Monitoring and evaluating processes in place Organisational flexibility Processes for new knowledge assimilation
ECOLOGICAL FIT		SPATIAL DIMENSION	Congruence between the geographical extent of the ecological problem and the territorial scope of the institution	Match between the PPA's location and the extent of the ecological issue
		TEMPORAL DIMENSION	Match of the activation of institutional responses to an environmental problem	Match between the temporal length of the legal tool and time needed for conservation actions
		FUNCTIONAL DIMENSION	Management of interlinked ecological system constituents	Interdependent management of ecological system constituents

especially to their nature as co-governance arrangements between public and private actors.

Finally, it is important to note that applying good governance criteria as benchmarks may be perverted as a technocratic exercise distracting from "how an output is achieved (…) to ask whether the outcome has been achieved" (Jenson & Levi 2013: 74). To avoid an apolitical approach, it is crucial to incorporate power, normative issues and the many values on which democracies depend (Dahl & Soss, 2014). Consequently, when assessing the social fit of a PPA (Part A), it is crucial to perform context-dependent validations of each of the principles and to pay special attention to the stakeholders' perceptions.

CONCLUDING REMARKS

The aim of this article was to inform the design of an assessment tool that would determine to what extent the institutional settings of PPAs enable their match with the connected dimensions of social and ecological fit. The interdisciplinary framework proposed is grounded in the theoretical and empirical research on social and ecological system fit and on the principles of good governance for PPAs. To sum up, we highlight the following potentialities as a diagnostic tool:

a. Underpinned by a conceptual framework of SESs, the tool is designed to take into account i) the core features and multi-dimensional dynamics of human–environmental interactions and ii) the co-evolutionary relationship between institutions and contextual settings.

b. This multi-criteria approach, which incorporates ecological and social fit dimensions, allows us to identify areas of poor performance and to negotiate choices around trade-offs.

c. By avoiding absolute definitions, each (social) principle can be operationalised on a context-dependent basis, incorporating different values and views.

Achieving a perfect institutional fit is, in practice, an almost impossible task due to the complexity of SESs, the limited research available and the existence of multiple (often conflicting) objectives. Indeed, some researchers prefer to prioritise a more realistic management of mismatches (Keskitalo et al., 2016). Under these circumstances, the proposed framework could be evolved to support complex decision-making and help to design more appropriate institutional models that are adaptable to dynamic settings.

ENDNOTES

[1] e.g. conservation easements, private reserves designations, land stewardship agreements and other forms of public–private partnerships.

[2] As explained in the Introduction, our framework will focus on the formal rules, referred to as 'institutional arrangements'.

[3] Lockwood (2010) argued that the capacity of a protected area to achieve its stated objectives (performance) should be assessed as input in a management effectiveness framework and should not be included in the process of the evaluation of governance quality. Put differently, performance intended as effectiveness is determined by, rather than a component of, good governance.

[4] https://www.metsonpolku.fi/en-US (accessed on 4/02/2020)

ACKNOWLEDGEMENTS

The authors wish to thank two anonymous reviewers for their detailed and costructive comments that helped to improve the manuscript. The first author acknowledges the financial support of the Portuguese Fundacão para a Ciência e a Tecnologia through the scholarship PD/BD/106025/2014 and through the PhD Program on Global Studies PD/FCT 00419/2012. The second author acknowledges the financial support of the Portuguese Fundacão para a Ciência e a Tecnologia through the science employment contract n. 7/2019/NT-GH-01. CENSE - Center for Environmental and Sustainability Research is financed by Fundacão para a Ciência e a Tecnologia (UID/AMB/ 04085/2019 e UIDB/04085/2020).

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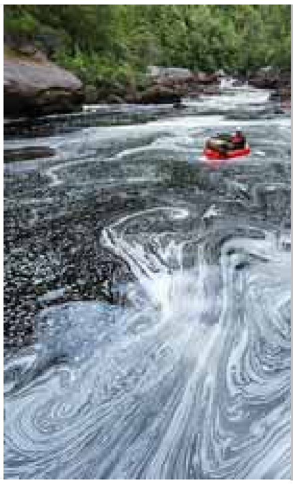
RESUMEN

Las áreas protegidas privadas (APP) constituyen una prometedora herramienta de gobernanza en el ámbito de la conservación para complementar las áreas protegidas públicas. A pesar de su promoción en los programas ambientales nacionales e internacionales y de su creciente adopción a nivel mundial, son pocas las investigaciones desarrolladas en torno a las repercusiones generales de su implementación. Este artículo presenta un marco para explorar la idoneidad de los acuerdos institucionales de las APP para mejorar la conservación de la naturaleza al tiempo que se satisfacen las necesidades de la sociedad. Para ello, nos apoyamos en la literatura sobre sistemas socio -ecológicos que incorporan ideas y perspectivas sobre la capacidad de acción y el poder. El enfoque conceptual resultante señala las interrelaciones entre los sistemas ecológicos y sociales, ofreciendo una perspectiva sistémica que sustenta un marco de diagnóstico interdisciplinario. Esto se basa en los conceptos de adaptación social y ecológica e integra las contribuciones de la literatura relacionada con la buena gobernanza y ajusta los principios de la buena gobernanza para adaptarlos a las APP. Esbozamos una herramienta de varios niveles para evaluar las APP. Se trata de un primer paso para abordar de manera integral la armonización de los modelos institucionales de las APP con las dimensiones ecológicas y sociales de sistemas complejos.

RÉSUMÉ

Les aires protégées privées (APP) sont considérées comme un outil de gouvernance à fort potentiel pour la conservation qui peut apporter un complément utile aux dispositifs en place dans les aires protégées publiques. Malgré la promotion des APP dans les programmes environnementaux nationaux et internationaux et leur adoption croissante dans le monde, peu de recherches ont été menées sur les implications globales de leur mise en œuvre. Cet article présente un cadre pour examiner la pertinence des dispositifs institutionnels des APP pour améliorer la conservation de la nature tout en répondant aux besoins sociétaux. Pour ce faire, nous nous appuyons sur des études de systèmes socio-écologiques intégrant des points de vue issus de perspectives critiques sur l'agence et le pouvoir. L'approche conceptuelle qui en résulte met en évidence les interactions entre les systèmes écologiques et sociaux, offrant une perspective systémique qui sous-tend un cadre de diagnostic interdisciplinaire. Cela s'appuie sur les concepts d'adéquation sociale et écologique et intègre des contributions de publications sur la bonne gouvernance; affinant ainsi les principes de bonne gouvernance en fonction des APP. Nous décrivons un outil à plusieurs niveaux pour évaluer les APP. Il s’agit d’une première étape pour aborder de manière globale la concordance des modèles institutionnels des APP avec les dimensions écologiques et sociales des systèmes complexes.



A REMOTENESS-ORIENTED APPROACH TO DEFINING, PROTECTING AND RESTORING WILDERNESS

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ABSTRACT
There is widespread recognition of the need to protect wilderness and its associated values, which are under increasing threat around the world. However, there is no consensus on how wilderness should be defined. This is not merely a semantic concern, as the definition of wilderness has real-world implications for how wilderness is identified, protected and managed. A globally agreed definition would provide a common framework for global and regional inventories of wilderness, and would be advantageous if wilderness is to be more systematically protected under the World Heritage Convention. Existing definitions vary in the emphasis that they place on ecological and experiential values, and in the stringency of the conditions that they set for an area to qualify as wilderness. Few definitions acknowledge the significance of remoteness, which is strongly linked to the experiential values of wilderness. Remoteness is also a measure of landscape integrity, which contributes to the ecological viability and other values of wilderness areas. Requiring a wilderness area to be large does not ensure that it will contain remote country. We propose a descriptive definition of wilderness that recognises its experiential as well as its ecological, Indigenous and other values, and that incorporates remoteness as a defining characteristic of wilderness. We discuss the implications of this definition for how wilderness is measured, classified, protected, managed and restored.

Key words: wilderness, definition, Wild Character, remoteness, experiential values, remoting area, wilderness region, wilderness protected area, wilderness restoration

INTRODUCTION
The word 'wilderness' is generally associated with extensive, wild and largely natural areas – areas free of roads and industrial infrastructure, and largely free of other evidence of disturbance by modern technological society (Kormos & Locke, 2008). We will henceforth use the word in this sense until we offer a more precise definition. It is generally accepted (e.g. Casson et al., 2016) that the condition of many wilderness areas has been influenced by the presence and/or activity (in some cases ongoing) of Indigenous people.

At a time of global environmental crisis, the preservation of wilderness areas is a matter of urgent priority. Such areas provide vital ecological functions, and have important Indigenous, experiential and sociocultural values. However, the extent and quality of such areas are declining globally due to a range of factors including anthropogenic climate change, forest clearance, road construction and tourism development (Kormos et al., 2015).

How we define wilderness reflects the values that we associate with wilderness and that we hold to be worth protecting. However, there is currently no consensus on the definition of wilderness (Carver & Fritz, 2016; see Table 1). This is far from a semantic concern, as the definition has real-world implications for how wilderness is identified, protected and managed (Hawes et al., 2018; Bastmeijer, 2016; Wartmann et al., 2019). A globally agreed descriptive definition and consistent terminology would provide a firm foundation for global initiatives to protect high-quality wilderness, particularly if wilderness is to be more systematically protected under the World Heritage Convention, as advocated by Kormos et al. (2015) and others.

WILDERNESS AS AN EVOLVING CONCEPT
The word wilderness is derived from northern European languages and originally referred to the 'place of wild animals' (Kormos & Locke, 2008). The modern conception of wilderness as a place of inspiration and wholesome recreation, as advocated by campaigners

such as Aldo Leopold, John Muir and others (Woods, 2017), emerged from the industrialisation of Europe and from the rapid expansion of roads, settlement, agriculture and extractive industries across the previously natural/Indigenous landscapes of the New World (Kormos & Locke, 2008).

Wilderness is therefore a primarily Western concept. However, comparable views of natural areas as places of spiritual replenishment, inspiration and sanctuary can also be found in other cultures, for example in third- and fourth-century Chinese poetry (Tin & Yang, 2016), in the forest preservation policies of Sri Lanka's Kandyan rulers (Alwis, 1999), in Russia's system of Zapovedniki (Casson et al. 2016), and in Indigenous conceptions of wilderness and sacred natural sites (Verschuuren et al., 2010).

The concept of wilderness has been and remains challenged by some postmodernists and Indigenous groups. One objection is that Western conceptions of 'naturalness' have historically ignored the role that Indigenous people have played in modifying the biota and landscapes of many areas now regarded as 'wilderness' (Casson et al., 2016). Contemporary definitions of wilderness redress this by stressing that wilderness includes areas that are or have been sustainably inhabited, utilised or influenced by Indigenous people following traditional, wilderness-based ways of life (Casson et al., 2016).

THE VALUES OF WILDERNESS

The values of wilderness have been described by Cordell et al. (2005), Casson et al. (2016) and many others. These values, which can be broadly categorised as ecological, Indigenous, experiential, sociocultural and intrinsic, are often coexistent and complementary. The fact that this is not always the case does not, in our view, justify leaving wilderness undefined or narrowing its definition to a single value (e.g. defining wilderness purely in terms of biodiversity). The following briefly summarises the values of wilderness, as a background to our argument that the definition of wilderness can and should take all of them into account.

Quartzite crags of the Eastern Arthur Range, Tasmanian Wilderness World Heritage Area, Australia © Martin Hawes.

Wilderness areas are places where ecological processes can continue largely unhindered by human development (Mackey et al., 1998; Dudley, 2013). They provide essential ecosystem services including climate stabilisation, carbon sequestration, nitrogen fixation and the maintenance of freshwater quality (Mittermeier et al., 2003; Kormos et al., 2015). They are essential to climate change mitigation and adaptation (Dudley, 2013). And they represent important biological benchmarks, providing examples of how intact or largely intact ecosystems function and evolve (European Commission, 2013). Although wilderness areas are not typically speciose, they hold the bulk of the planet's biomass and the last remaining intact megafaunal assemblages (Mittermeier et al., 2003; Watson et al., 2016). They are now the only places that contain mixes of species at near-natural levels of abundance (Watson et al., 2018). They act as a buffer against species loss, as the average extinction risk for species within wilderness is less than half that of species in non-wilderness communities (Di Marco et al., 2019).

Wilderness areas are often areas of immense cultural and spiritual significance to Indigenous people. Many are home to Indigenous cultures living at low densities, and provide livelihoods to local communities – communities that are often politically and economically marginalised (Casson et al., 2016; Watson et al., 2016). Some Indigenous people have embraced wilderness preservation as a way of protecting their culture and heritage (Cessford, 2001; Confederated Salish and Kootenai Tribes, 2005).

The experiential values of wilderness include opportunities for challenging, self-reliant recreation, physical and mental challenge, solitude, freedom, inspiration, awe, wonder, transformation and connection (Ashley et al., 2015). Journeys into wild places can bring benefits in terms of physical, mental and spiritual health, including reduced risks of disease and lower stress levels (Ewert et al., 2011). The existence, character and beauty of such areas can be appreciated and enjoyed vicariously through media such as writing and photography, or simply by contemplation

(Ashley et al., 2015). Many people find solace just from knowing that wilderness exists (e.g. Weinberg, 2014).

Wilderness areas are associated with cultural values and non-material benefits for both Indigenous and non-Indigenous populations, such as solitude, respect for sacred sites and respect for ancestors (Dudley, 2013). They provide avenues to change human attitudes, belief systems and behaviours, for example by fostering environmental consciousness (Ewert et al., 2011). They are an invaluable resource for education and for inspiring cultural and artistic expression (European Commission, 2013).

There is growing appreciation of the intrinsic value of nature and the importance of respecting and protecting the diversity of life on Earth, regardless of its direct or even indirect benefit to humans (Casson et al., 2016). Many people believe that areas of the natural world that exist and flourish in a largely unaltered condition, independently of human needs and desires, have intrinsic value (Nelson & Vucetich, 2013).

WILDERNESS AND REMOTENESS

The significance of remoteness

The experiential values of wilderness are strongly linked to its remoteness, for three closely related reasons. Firstly, remote settings can be perceived and experienced as places where extensive landscapes remain largely undisturbed by anthropogenic disruptions such as road construction, mining and the clearance of native vegetation. They are places where the visitor can stand with their senses steeped in nature and be confronted with the vastness of the natural world (Hawes et al., 2018).

Secondly, remote settings provide opportunities for challenging and self-reliant recreation, particularly if they require at least one overnight stay in a remote location (Dudley et al., 2012). Such settings can also offer outstanding opportunities for solitude.

Thirdly, the impact on experiential values of anthropogenic features such as buildings, and of activities such as aircraft overflights, is not confined to their immediate footprints but extends over surrounding areas (Carver & Tin, 2015). This impact is best conceptualised and measured as a continuous rather than a binary variable, and is best defined in terms of 'remoteness from' rather than 'the absence of' features such as buildings and disturbances such as overflights.

The remoteness of an area can contribute to its ecological values. Physical distance from disturbances such as logging and land cleared for agriculture can help to buffer an area from ecological impacts such as anthropogenic fire, air and water pollution, and invasive species (Landres, 2013). Access-time remoteness can help to protect it from impacts such as poaching and recreational trampling (Hawes et al., 2018). Research indicates that the ecological impacts of roads extend several kilometres beyond their immediate footprint (Ibisch et al., 2016). As we explain below, protected areas designed to optimise remoteness have spatial characteristics including largeness that are conducive to ecological protection. Remoteness can also protect cultural and archaeological features (such as sacred sites) from impacts such as theft, vandalism and unsanctioned visitation (DPIPWE, 2016).

Some definitions of wilderness explicitly require wilderness areas to be remote or to have qualities of remoteness (e.g. Robertson et al., 1992; DPIPWE, 2016). Others imply or mention remoteness without explicitly requiring it (e.g. US Wilderness Act 1964; European Commission, 2013). Measurements of remoteness and naturalness are used in one form or another in nearly all models of wilderness quality (Carver & Fritz, 2016). Landres et al. (2015) note that remoteness from the sights and sounds of civilisation is important for achieving a sense of solitude.

Remoting areas and wilderness regions

There is already considerable confusion around the meaning of terms such as 'wilderness area', and we appreciate the risks associated with offering additional definitions. Nevertheless, if the significance of remoteness is to be adequately recognised, the definition of wilderness should reflect this. This requires that a new (or at least refined) definition of wilderness be introduced, as well as some new terminology. Moreover, it requires that the definition of these terms be crystal clear and carefully observed.

Any location or area that is remote (for example from roads and buildings) must necessarily be surrounded by a tract of land or sea whose undeveloped condition (for example, absence of roads and buildings) makes that location or area remote. We will use the term *remoting area* to refer to this surrounding area. Note that we are using this term descriptively, not as a management designation.

If, as we recommend, one defines wilderness in a way that requires it to be remote, then any area of wilderness must necessarily (i.e. logically) have an associated remoting area.

For example, suppose one defines wilderness simply as land that is at least 5 km remote from the nearest road. Figure 1 shows a region that contains a network of roads as well as a substantial area of roadless country. The area shaded green in Figure 1 depicts the '5 km wilderness', and the yellow area is its associated remoting area.

Note that the remoting area extends out to roads in some places but not in others. Additional road construction outside the remoting area would not affect the area of the '5 km wilderness', but the intrusion of roads anywhere inside the remoting area would reduce the area of wilderness.

We propose establishing more elaborate standards of remoteness that an area needs to satisfy to qualify as wilderness. But the concept of a remoting area is still valid: it is the area whose existence and undeveloped condition (such as being free of roads and other major infrastructure) ensures that the wilderness area meets those standards.

We will use the term *wilderness region* to refer to any region comprising one or more wilderness areas and their associated remoting areas. For example, in Figure 1 the boundary of the wilderness region coincides with the outer edge of the yellow area.

Size, compactness and contiguity

The capacity of an area to offer and protect ecological and experiential values is dependent on both its size (i.e. largeness) and shape. In general, the largeness of an area contributes to its 'wildness' and its capacity to offer opportunities for solitude and other spiritual experiences (European Commission, 2013). Larger areas can also enhance the options and opportunities for ecological conservation (European Commission, 2013; Dudley, 2013).

The compactness and contiguity of an area are also relevant to its capacity to protect ecological values (Nalle et al., 2002). While 'elongated' and fragmented areas may encompass a greater range of environments and habitats, their higher edge-to-area ratio relative to more compact, 'circular' areas negatively influences species survival (Durán et al., 2016). Larger, more intact natural areas have higher inherent connectivity, providing the best opportunities for effective long-term retention of species and communities and ecological processes, including buffering against large-scale threatening processes such as climate change and fire (Lesslie, 2016). For these reasons, protected areas are generally recommended to have compact shapes (Durán et al., 2016).

The relationship between remoteness and size, compactness and contiguity

Many current definitions of wilderness require wilderness areas to be large. However, large size does not guarantee that an area will be compact or contiguous, nor that it will contain remote country. This is illustrated in Figures 2–5.

The areas shaded green in Figures 2 and 3 represent roadless regions bordered by roads. It is assumed that the two regions are free of other major infrastructure such as buildings and are in a largely natural condition. Region 2 excludes a narrow corridor of land bordering a mine and its access road. The two regions have the same surface area (just over 110,000 hectares).

Since both regions are large, both would qualify as 'wilderness areas' by many definitions. Indeed, if one ignores the relevance of remoteness to wilderness values, the equivalence of the two regions in terms of size and naturalness would appear to translate into an equivalence of wilderness values. However, Figures 4 and 5 illustrate that Region 1 encompasses substantially larger areas of remote land, and land with substantially higher remoteness, than does Region 2. Note that the road and mine in Region 2 have a drastic impact on its remoteness, despite having little impact on its overall area. Note also that the 'peninsula' of land at point A

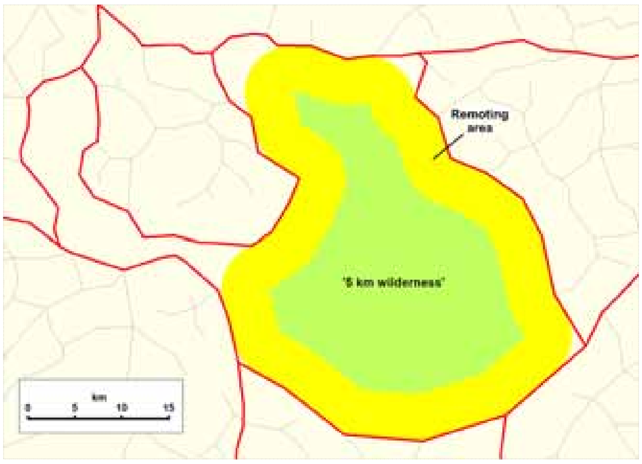


Figure 1. An area of 5-km remote wilderness and its associated remoting area. Red and grey lines indicate major and minor roads respectively

Figure 2. Region 1—the green area indicates a roadless region. Major and minor roads are indicated with red and grey lines respectively.

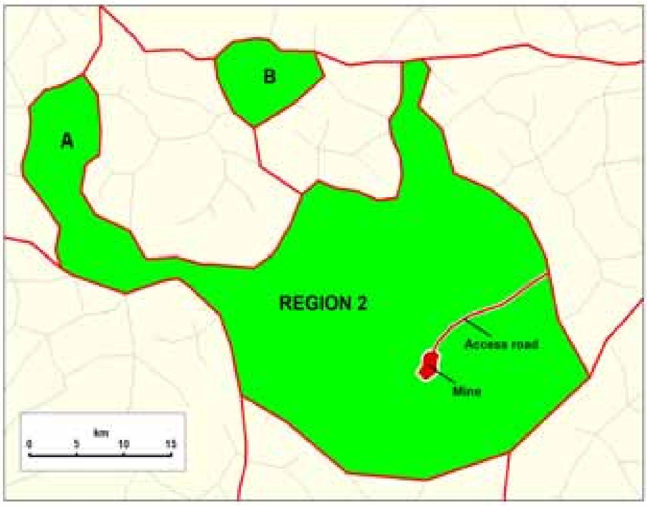


Figure 3. Region 2 (which includes area B) is also roadless, and has the same surface area as Region 1. The region excludes a narrow corridor of land bordering a mine and its access road

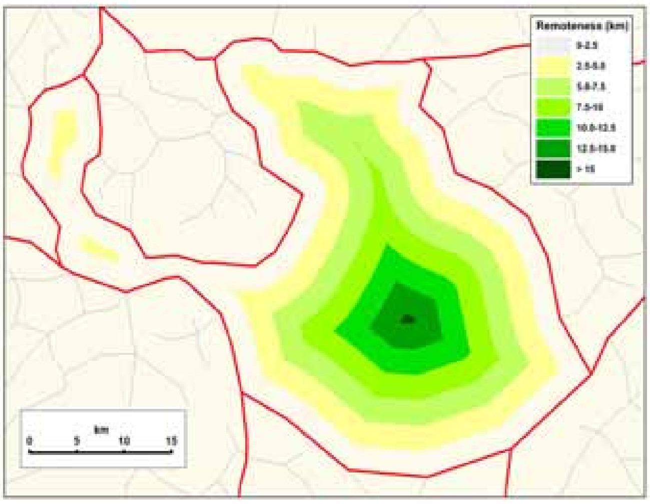


Figure 4. Isolines of remoteness from roads, shaded in 2.5 km intervals, within Region 1

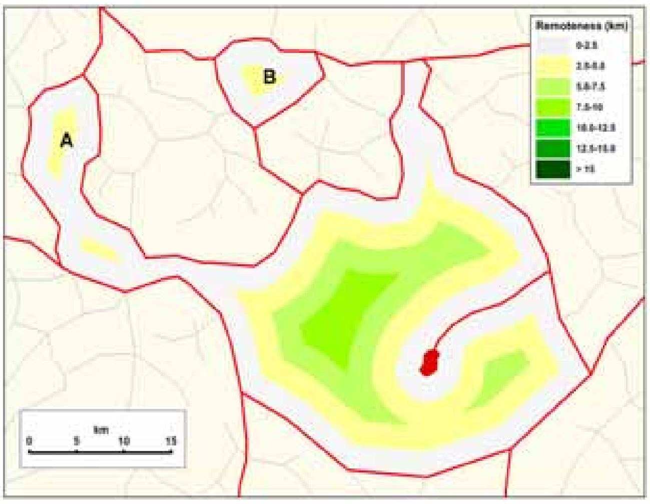


Figure 5. Isolines of remoteness from roads, shaded in 2.5 km intervals, within Region 2

and the outlier at point B, while contributing significantly to the area of Region 2, contribute little to its remoteness.

The converse of our earlier statement is not true, since requiring wilderness to be remote does ensure that the wilderness region associated with any wilderness area will be large. The wilderness region corresponding to a contiguous wilderness area will also be contiguous and will tend to be compact, since the buffering associated with the remoting area will tend to smooth any indentations in the wilderness area to which it corresponds (see Figure 1).

DEFINING WILDERNESS

Ecological refuge or recreational asset?

Much of the emphasis of early campaigns to protect wilderness focused on its experiential values (Woods, 2017), a fact that is reflected in, for example, the wording of the US Wilderness Act 1964. Since the 1990s, the prevailing focus of wilderness protection, and indeed of conservation generally, has been ecological (Mackey et al., 1998; Casson et al., 2016), to the point where the other values of wilderness are frequently overlooked (Sawyer, 2015; Bastmeijer, 2016). In consequence, some current definitions of wilderness are couched purely in ecological terms.

Description or management designation?

Casson et al. (2016) identify three ways in which the word 'wilderness' is used: as a descriptor of the condition of an area, as a management designation, and as a designator of a set of cultural values. They point out that the word is often used loosely and colloquially to refer to almost any manifestation of naturalness, in contrast to artificial human environments. Here we are concerned only with the first two uses of the word, and it is important to draw a clear distinction between them, particularly when defining the terms 'wilderness' and 'wilderness area'.

The descriptive use equates the terms 'wilderness' and 'wilderness area' with the actual condition of an area of land (or sea). The 'condition' in question is likely to include the area's biological naturalness, but it may also include factors such as its remoteness, the presence or otherwise of human infrastructure, and usage factors such as accessibility by motorised vehicles. Crucially, the description as wilderness or non-wilderness applies regardless of an area's management designation.

Used as a management designation, the term 'wilderness area' designates the conditions that a management regime is intended to maintain or attain, whether or not those conditions actually exist within the designated area.

The descriptive and designative uses of the terms 'wilderness' and 'wilderness area' are sometimes referred to as de facto and de jure (e.g. Cao et al., 2019). The distinction is particularly relevant to the question of whether wilderness (or a wilderness area) needs to be remote and/or large. For example, the narrowest parts of Region 2 in Figure 5 might be part of a designated 'wilderness area' by some definitions. But these areas are not remote, and hence are not wilderness by our recommended definition.

Other considerations relevant to how wilderness is defined

Definitions can be either qualitative or quantitative, the latter specifying thresholds (such as minimum size or remoteness) that an area must satisfy to qualify as 'wilderness' or as a 'wilderness area'.

If thresholds are set, a key question is whether the bar is set high or low. An argument could be made for reserving the word 'wilderness' for exceptionally wild areas, such as parts of the Serengeti and the Gates of the Arctic. At the other extreme, Diemer et al. (2003) used the term 'wilderness' to refer to revegetating urban

Rafting a remote river in the Tasmanian Wilderness World Heritage Area, Australia © Grant Dixon

areas as small as 20 ha, including former railway yards and mine areas. Such designations may be advantageous in terms of protecting the areas in question, but they risk weakening the meaning of the word 'wilderness' and fostering the belief that industrial and other development are acceptable in or adjacent to wilderness areas.

Thresholds are also relevant to the determination of naturalness, especially in the Anthropocene epoch when no part of the planet is entirely free from human pollution or immune to the effects of climate change. Moreover, as we noted earlier, many areas that may now be considered wilderness have been modified ecologically by past and/or ongoing use by Indigenous people. Clearly no wilderness area can be counted as entirely natural. Rather, wilderness must be defined in terms of naturalness relative to more intensively modified, polluted and developed environments.

Scale is also relevant here, as the criteria that might be appropriate for a global or continental inventory of wilderness might be unsuitable for assessing wilderness at a regional level (Wartmann et al., 2019).

Current definitions of wilderness

Table 1 lists several current definitions of wilderness (necessarily abbreviated). Note that the European Commission and Kormos et al. (2015) definitions are descriptive. The IUCN and US Wilderness Act definitions are management designations, although they include descriptive elements insofar as they stipulate the minimum conditions of size and naturalness that an area must satisfy in order to be designated as

Table 1. Examples of existing definitions of wilderness*

Agency/author	Definition
IUCN	Category Ib protected areas [i.e. wilderness areas] are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition. (Dudley, 2013)
US Wilderness Act 1964	A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain.
European Commission	A wilderness is an area governed by natural processes. It is composed of native habitats and species, and large enough for the effective ecological functioning of natural processes. It is unmodified or only slightly modified and without intrusive or extractive human activity, settlements, infrastructure or visual disturbance. (European Commission, 2013)
The Wild Foundation	The most intact, undisturbed wild natural areas left on our planet – those last truly wild places that humans do not control and have not developed with roads, pipelines or other industrial infrastructure. (Wild Foundation, undated)
Tasmanian Wilderness World Heritage Area Management Plan 2016	A wilderness area is an area that is of sufficient size, remoteness and naturalness to enable the long-term integrity of its natural systems, diversity and processes, the maintenance of cultural landscapes and the provision of a wilderness recreational experience. (DPIPWE, 2016)
Kormos et al. (2017)	Landscapes and seascapes that are biologically and ecologically largely intact, with a low human population density and that are mostly free of industrial infrastructure.

* Note: The text here comprises excerpts only. The full definitions are in some cases much longer.

wilderness. Note also that the Kormos definition is couched almost exclusively in ecological terms. Other definitions acknowledge experiential and cultural values to varying degrees, but most give greater emphasis to ecological values.

RECOMMENDED APPROACH TO DEFINING, MEASURING, DELINEATING AND CLASSIFYING WILDERNESS

Recommended definition

In view of our concerns about the shortcomings of existing definitions of wilderness, we have drafted and recommend the following qualitative, descriptive definition. The definition is relevant to wilderness on land, including inland waterways.

Wilderness is land characterised by a high degree of biophysical naturalness, linear remoteness from infrastructure and landscape disturbances, and time-remoteness from points of mechanised access, as well as having minimal evidence of modern technological society. Wilderness by this definition can include areas that are or have been sustainably inhabited, utilised and influenced by Indigenous people following traditional, wilderness-based ways of life.

This definition encompasses the ecological, Indigenous, experiential, sociocultural and intrinsic values of wilderness, and recognises remoteness as a defining characteristic of wilderness.

As the definition is qualitative, we believe it is potentially applicable to all parts of the world and all environments. The fact that the term 'high degree' is relative allows the definition to be interpreted according to the levels of wildness that prevail wherever it is being applied.

We recommend the term *Wilderness Protected Area* (WPA) to designate areas whose primary management objectives are nature conservation and the preservation and/or restoration of wilderness. Henceforth, we will use the term 'wilderness area' solely in a descriptive context, i.e. to mean an area of wilderness as defined above.

Measuring and mapping wilderness

It is clearly desirable that a methodology for measuring and mapping wilderness be conceptually compatible with the way wilderness is defined.

Methodologies for measuring and mapping wilderness date back to at least the 1960s (e.g. Penfold, 1961). Two key approaches can be identified, namely the 'binary' approach that distinguishes 'wilderness' from 'non-wilderness', and the 'continuum' approach that assesses wilderness quality (or a similar term) as a continuous variable with no definite boundary. Global wilderness assessments (McCloskey & Spalding, 1989; Mittermeier et al., 2003; Watson et al., 2016) have taken a binary approach based on area and other factors. A 'continuum' methodology developed in Australia by Lesslie and Taylor (1985), which has become the template for subsequent wilderness assessments in many parts of the world, defined wilderness quality as the sum of four components, three of which were defined in terms of remoteness.

Cao et al. (2019) used a combination of binary and continuum approaches to assess wilderness in China, initially identifying wilderness areas based on remoteness, and then classifying these areas according to their mean wilderness quality. Comber et al. (2010) and Fritz et al. (2000) assessed wilderness based on surveys of user perceptions, incorporating fuzzy logic into the calculation of wilderness values. While the latter approaches are arguably more 'real-world' and sophisticated, the authors acknowledge that their complexity 'has not increased the ease of decision making' (Comber et al., 2010).

We endorse existing remoteness-based methodologies for measuring wilderness, particularly those based on variants of the Lesslie and Taylor (1985) approach. We recommend using the term *Wild Character* to refer to the quantity measured by continuum-based methodologies, as it can be usefully applied not only to wilderness areas but also to non-wilderness areas that have a significant degree of wildness. The term also helps to clarify the distinction between wildness (Wild Character) as a continuum and wilderness/non-wilderness as a binary classification.

Recommended approach to delineating and classifying wilderness areas

Wilderness protection requires drawing lines on maps (Bastmeijer, 2016). Delineating wilderness based on thresholds of remoteness is a simple approach clearly related to our recommended definition. Such a classification system would be potentially useful for regional and global wilderness assessments, and as a basis for wilderness management.

Perceptions of what constitutes wilderness vary widely (Kliskey & Kearsley, 1993; McMorran et al., 2008). What might pass for wilderness in Europe might barely rank as such alongside many Alaskan or Siberian wilderness areas. To accommodate such variations, we propose a 4-tiered classification system for wilderness. The system can be applied either descriptively or prescriptively: for example, Class B could apply either to a wilderness area (regardless of its management status), or to a WPA whose function is to protect a Class B wilderness area.

The system is based on thresholds of linear remoteness and access-time remoteness (see Figure 6 and Table 2). The former would be measured from major infrastructure such as roads, dams, power lines and major buildings, as well as from areas of significant disturbance of the environment such as logging areas, land cleared for agriculture, impoundments and plantations. The latter would be measured from points of mechanised public access including publicly accessible roads, navigable waterways and aircraft landing sites.

The classification system proposed here is similar to the European Wilderness Quality Standard and Audit System proposed by the European Wilderness Society (2019). However, the latter has been formulated solely in a European context, and while it takes size into account, it only indirectly takes account of remoteness. Our least remote category of wilderness (i.e. Class D) might better be called 'wild area', a term that is often preferred in a European context (European Wilderness Society, 2019).

The half-day threshold of access-time remoteness (nominally 3.5 hours, in terms of travelling time without breaks) has particular significance because visiting areas exceeding this threshold requires an overnight stay in roadless country. The 5 km threshold of linear remoteness has been used in other studies, such as those by Ólafsdóttir et al. (2016). Ibisch et al. (2016) determined that 14 per cent of road-related impacts extended 5 km from roads.

For wilderness of any category to exist, it must (logically) be surrounded by a remoting area that

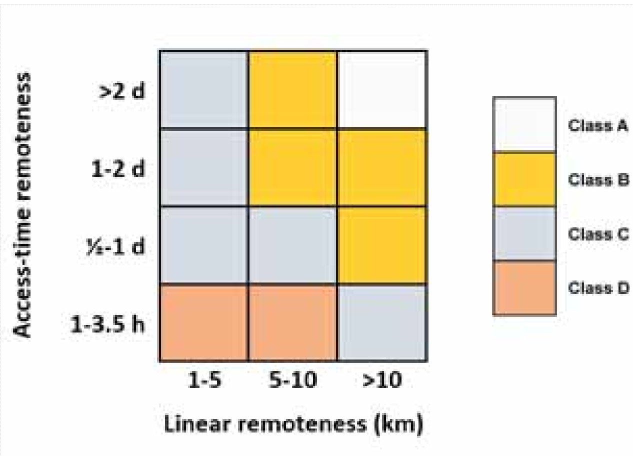


Figure 6. Suggested wilderness classification system based on thresholds of linear and access-time remoteness

Table 2. Some characteristics of our suggested wilderness classification system, with examples. See also figure 6.

Proposed wilderness classes	Description
Class A	'Crème de la crème' wilderness, having a high degree of both linear and access-time remoteness (at least two days and 10 km). Examples: Extensive areas of Jaú National Park, Brazil; Thoroughfare region of Teton Wilderness, USA.
Class B	Wilderness areas that are at least 5 km and one day remote, or at least 10 km and half a day remote. Examples: Lake Kardyvach, Kavkazkiy Nature Reserve World Heritage Area, Russia; Pelion Range, Tasmanian Wilderness World Heritage Area, Australia.
Class C	Wilderness areas that are at least half a day or 10 km remote. The half-day requirement ensures that visiting such areas requires at least one overnight stay in a roadless area. Class C can include areas such as mountains and gorges that have low linear remoteness but moderate access remoteness owing to rugged terrain. Examples: 'Wildnisgebiet Sulzbachtäler' wilderness area, Hohe Tauern National Park, Austria; Bruneau-Jarbidge Rivers Wilderness, USA.
Class D	Wild areas that are at least 1 hour remote and less than 10 km remote. Such areas provide a degree of immersion in the natural world, but are not remote enough to qualify as fully-fledged wilderness. Examples: Parts of Dartmoor National Park, UK; narrow coastal section of Daniel J. Evans Wilderness, Olympic National Park, USA.

accounts for both its linear and access-time remoteness. For example, if an area is one day and 10 km remote, it must be surrounded by a remoting area that extends out to a distance of one day (in non-mechanised travel time) and 10 km.

Ecological naturalness is accounted for in a very basic way by requiring wilderness to be remote from disturbances such as logged areas. Remoteness from roads also tends to ensure a higher probability of naturalness. If necessary, additional criteria of naturalness can be imposed for areas to qualify as wilderness.

The question remains whether it would be preferable to delineate wilderness based on more sophisticated measurements, for example by defining Class C wilderness as areas where Wild Character exceeds a specified value. An advantage of doing so is that measurements of Wild Character could take account of a much wider range of variables, for example proximity to settlements and the extent of viewshed disturbance. The disadvantage is that, having thus identified 'wilderness', it would then be very difficult to determine the extent and management requirements of its associated remoting area, owing to the complexity of the formulas whereby Wild Character is calculated.

For this reason, we recommend using simple criteria to delineate wilderness, and then using the more sophisticated approach of Wild Character measurements to fine-tune its management.

SUMMARY & POLICY IMPLICATIONS

Wilderness has outstanding ecological, Indigenous, experiential, sociocultural and intrinsic values of regional and global significance. However, there is currently no globally agreed (descriptive) definition of wilderness. The experiential values of wilderness are strongly linked to remoteness, which also contributes to its ecological values. Large size does not guarantee remoteness, but the requirement that wilderness areas be remote ensures that their associated wilderness regions will be large and have spatial characteristics such as contiguity and low boundary-to-area ratio that are advantageous for ecological conservation.

We recommend a descriptive definition of wilderness that encompasses the full range of its values and that identifies remoteness as a defining characteristic of wilderness. We also recommend delineating and classifying wilderness areas based on remoteness thresholds. These recommendations have significant implications for the design and management of WPAs.

Design and management of WPAs

The principal objective of wilderness management is to maximise remoteness from, and minimise modifications by, the impacts and influences of modern technological society (Mackey et al., 1998). To this end, WPAs must include, at a minimum, wilderness areas and their associated remoting areas. In other words, they must include entire wilderness regions as we have defined them.

The primary management objectives of a WPA should be both to conserve nature and to maintain or restore the extent and Wild Character of the wilderness it contains. To achieve this, the entire WPA must be kept free of the kinds of infrastructure (such as roads and buildings) relative to which remoteness is defined, and free of mechanised access.

Beyond this basic requirement, the maintenance of Wild Character will require projected Wild Character to be assessed ahead of any proposed management changes or infrastructure development. Wild Character assessments should, if practical, take account of factors such as viewshed disturbances and noise pollution.

WPAs may or may not be part of larger protected areas whose function outside the WPA relates to the protection of values other than wilderness.

Wilderness and Indigenous communities

The protection of the rights of Indigenous peoples to access and utilise their traditional lands is of vital importance (Casson et al., 2016). It is generally accepted that where Indigenous communities have pre-existing interests in and rights to wilderness areas, they should be involved from the outset in the designation and management of those areas (Casson et al., 2016).

By many definitions, including the one that we recommend, wilderness can include areas that are or have been sustainably inhabited, utilised and influenced by Indigenous people following traditional, wilderness-based ways of life.

By the definition that we recommend, features associated with modern technological society such as vehicular tracks and modern buildings, and activities such as the use of motorised vehicles, would count as 'infrastructure' and as 'evidence of modern technological society' regardless of the cultural affiliations of the people who construct or engage in them. In some situations, developments in wilderness areas such as the construction of roads or communications towers might be justified on grounds such as traditional land rights and social equity; but by our definition they would be counted as a loss of wilderness.

Implications for the IUCN protected area classification system

At present, the IUCN system has a special category, namely category Ib, for wilderness areas as defined by IUCN (Dudley, 2013; see Table 1). A potential weakness of the Ib classification is that it does not ensure that remoteness is valued and protected. We recommend

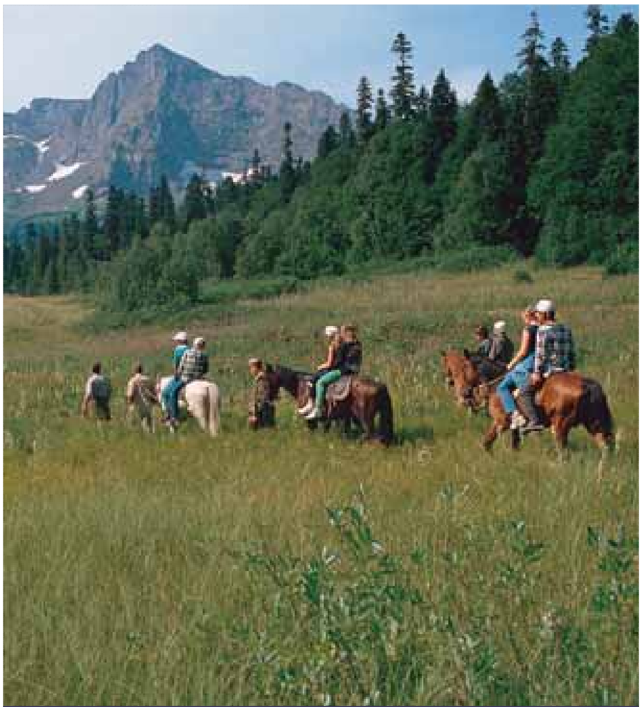
Glaciated high peaks of the Central Karakoram National Park and proposed World Heritage Area, Pakistan © Grant Dixon that the IUCN prescriptions for Ib areas be modified to acknowledge the significance of remoteness. Existing Ib areas that do not facilitate the protection and/or restoration of wilderness as we have defined it should be considered for reclassification, for example as Category Ia.

Wilderness restoration

There is currently strong interest in pursuing options for restoring wilderness, particularly in Europe where few areas of original wilderness remain (Periera & Navarro, 2015), and where the abandonment of marginal agricultural land provides opportunities for restoring some form of 'wilderness' (Höchtl et al., 2005).

In broad terms there are two pathways to restoring wilderness, namely restoring naturalness and restoring remoteness; in practice, both might be followed. The former may involve measures such as discontinuing grazing or allowing previously logged forests to regenerate (Măntoiu et al., 2016).

Restoring remoteness can potentially be achieved in significantly shorter timescales if it involves measures such as the exclusion of public vehicular access, the closure and rehabilitation of vehicle tracks, or the removal of infrastructure such as cable cars and forest tracks (Plutzar et al., 2016).



Schoolchildren and guides in the Kavkazkiy Nature Reserve, Western Caucasus World Heritage Area, Russia © Martin Hawes

ACKNOWLEDGEMENTS

We are grateful to Nick Sawyer, Paul Smith and Chris Bell, who contributed greatly to the development of the ideas that we express in this paper. Numerous researchers and wilderness specialists, in particular Peter Ashley, Kees Bastmeijer, Bastian Bertzky, Ian Brown, Steve Carver, Kevin Hood, Cyril Kormos, Peter Landres, Geoff Law, Les Molloy, Haydn Washington, and three anonymous reviewers, contributed valuable feedback and suggestions. Our special thanks to Glenys Jones, who helped to finance the preparation of this paper and contributed to its editing.

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LEGISLATION

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RESUMEN

Hay un reconocimiento generalizado en torno a la necesidad de proteger las áreas silvestres y sus valores asociados, que se encuentran bajo creciente amenaza en todo el mundo. Empero, no hay consenso sobre cómo deben definirse las áreas silvestres. No se trata de una preocupación meramente semántica, ya que la definición de las áreas silvestres tiene repercusiones muy reales en cuanto a la forma en que se identifican, protegen y gestionan dichos espacios naturales. Una definición acordada a escala mundial proporcionaría un marco común para los inventarios mundiales y regionales de las áreas silvestres, y sería muy provechoso si las áreas silvestres fueran protegidas de manera más sistemática en el marco de la Convención del Patrimonio Mundial. Las definiciones existentes varían en términos del énfasis que ponen en los valores ecológicos y experienciales, y en el rigor de las condiciones que establecen para que un espacio pueda calificarse como área silvestre. Pocas definiciones reconocen la importancia de la lejanía, que está estrechamente relacionada con los valores experienciales de las áreas silvestres. La lejanía es también una medida de la integridad del paisaje, que contribuye a la viabilidad ecológica y a otros valores de las áreas silvestres. Exigir que un área silvestre sea muy extensa no garantiza que sea remota. Proponemos una definición descriptiva de las áreas silvestres que reconozca sus valores tanto experienciales como ecológicos, indígenas y de otro tipo, y que incorpore la lejanía como una característica definitoria de las áreas silvestres. Examinamos las consecuencias de esta definición en función de la forma en que se miden, clasifican, protegen, gestionan y restauran las áreas silvestres.

RÉSUMÉ

La nécessité de protéger la nature sauvage et ses valeurs associées, qui sont de plus en plus menacées dans le monde, est largement reconnue. Cependant, il n'y a pas de consensus sur la façon dont la nature sauvage devrait être définie. Ce n'est pas simplement une préoccupation sémantique, car la définition de zone de nature sauvage a des implications réelles sur la façon dont la nature sauvage est identifiée, protégée et gérée. Une définition reconnue à l’échelle mondiale fournirait un cadre commun pour les inventaires mondiaux et régionaux de zones de nature sauvage, et pourrait s’avérer bénéfique pour une protection plus systématique de la nature au titre de la Convention du patrimoine mondial. Les définitions existantes varient selon l’accent mis sur les valeurs écologiques et expérientielles et la rigueur des conditions établies pour qu’une zone soit qualifiée de zone de nature sauvage. Peu de définitions reconnaissent l’importance de l’éloignement, qui est pourtant fortement liée aux valeurs expérientielles de la nature sauvage. L'éloignement est également une mesure de l'intégrité du paysage, qui contribue à la viabilité écologique ainsi qu’à d'autres valeurs intrinsèques des zones de nature sauvage. Exiger qu'une zone de nature sauvage soit grande ne garantit pas qu'elle incorporera des régions excentrées. Nous proposons une définition descriptive de zone de nature sauvage qui reconnaît ses valeurs expérientielles ainsi que ses valeurs écologiques, autochtones et autres, et qui intègre l'éloignement en tant que caractéristique déterminante. Nous étudions l’incidence de cette définition sur la façon dont la nature sauvage est mesurée, classée, protégée, gérée et restaurée.

MUCH ADO ABOUT NOTHING: A CONCEPTUAL DISCUSSION ON NOVEL OR NICHE TOURISM IN PROTECTED AREAS

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ABSTRACT
The character of tourism in protected areas has remained predominantly unchanged over time. Should a new approach to tourism and recreational zonation in protected areas accommodate a broader spectrum of nature-based tourism activities? Using naturism as a novel example, this form of tourism could be accommodated by applying spatial and temporal recreational zonation of protected areas and associated facilities. In the face of growing dependence on revenue from tourism, it is concluded that policies governing tourism in protected areas be revised. This revision should be transparent and uniform to generate predictable outcomes or decisions, irrespective of the personal biases, values or subjective judgements of decision-makers. The uncertainty associated with introducing a novel tourism activity into a protected area may be addressed through simultaneously applying the precautionary principle and adaptive management in a limited stepwise manner.

Key words: adaptive management, nature-based tourism, niche tourism; nudism; precautionary principle; protected area; zonation

INTRODUCTION
In 2014, the Hibiscus Coast Municipality, currently known as the Ray Nkonyeni Municipality, located on the south coast of KwaZulu-Natal, South Africa, decided to formalise a portion of beach as an area set aside for recreational activities undertaken in a naked state – "a nudist-friendly beach". Naturists had been using the area informally for some years on account of its position on a secluded stretch of coastline within the Mpenjati Game Reserve and Trafalgar Marine Protected Area of KwaZulu-Natal (Figure 1) (News24, 2016). The decision taken by the Municipality was in response to a request by both the South African and KwaZulu-Natal Naturists Associations to formally establish a "nudist-friendly beach at the Mpenjati Estuary" (Mkhwebane, 2017).

The formalisation of a nudist beach by the Municipality was opposed by Reverend M. Effanga on behalf of the 'Concerned Citizens of the Hibiscus Coast Municipality', who, on 16 December 2015, lodged a complaint with the Public Protector (Box 1), within the context that public nudity was morally offensive, that the process followed by the Municipality in formalising the area as a nudist beach was, *inter alia*, maladministered, not based in legality, and prejudicial towards the complainant community (Mngoma, 2017; Pretorius, 2017). In addition, Reverend Effanga stated that the decision was illegitimate (Mkhwebane, 2017). The relief requested of the Public Protector was to "remedy or right the wrong" – this being to set aside the decision taken by the Municipality (Mkhwebane, 2017). In 2017, the Public

Figure 1. The location of informal nudist beaches along South Africa's coast

Box 1. The Public Protector in South Africa

In the transition to a democratic country, the Public Protector replaced the ombudsman system that was in place during South Africa's apartheid era. The Public Protector is a constitutionally derived institution that monitors the duties performed by the public administration and enforces the accountability of the three tiers (national, provincial and local) of the South African government. Simply put, the Public Protector is obligated to function as an "independent and impartial upholder of the highest standards of efficient, effective, just and fair public administration" (Brynard, 2000), and can be called on by members of the public to investigate and where necessary initiate remedial action where an organ of state has acted outside the rule of law. At the time of drafting this paper, Advocate Busisiwe Mkhwebane has been appointed as South Africa's Public Protector.

Protector found in favour of the Concerned Citizens of the Hibiscus Coast Municipality, which halted the formalisation of the nudist beach. This finding was based on procedural grounds and not on the legality of nudism. The lawfulness of nudism in South Africa appears to hinge on whether this activity is conducted in a 'public place' or not (Blackmore, forthcoming). Protected areas, even though accessible to the public, in this country, fall outside of what is considered (in law) a 'public place'. It, therefore, appears that nudism may be a legitimate activity that may take place in these areas (Blackmore, forthcoming).

Using South African protected areas as a point of reference, this paper undertakes a brief analysis of the current context of nature-based tourism. The objective of this analysis is to answer the generic question as to whether existing or scheduled protected area tourism may include markets not traditionally accommodated in these areas? For this, naturism, natourism, naturalism or nudism-based tourism serves as an example in determining whether this activity may be included as a recreational activity within terrestrial protected areas. In so doing, this paper ventures into the territory of novel or niche tourism in an attempt to stimulate a reconsideration of the kinds of tourism that may take place in protected areas.

ANALYSIS AND DISCUSSION

Although nudity or partial nudity has openly persisted as a social norm in many South African indigenous cultures and ceremonial events, the country has had a long history of outlawing public nudity, and it is generally seen as taboo (Cook & Hardin, 2013). Nonetheless, a number of popular, but unofficial, nudist beaches (i.e. Sandy Bay in Table Mountain National Park, Great Fish Point Lighthouse, Secrets Beach, north bank of the river mouth in the Mpenjathi Nature Reserve, and northern beach at Umhlanga Rocks: see Figure 1) arose informally during the 1980s in conservative apartheid South Africa (Bartlo, 2005). These areas have persisted or been tolerated as 'nude or nudist-friendly beaches', despite ad hoc arrests and doubtless prosecution of offending naked bathers by the law enforcement agencies. Given the opinion of various sectors in society against public nudity, and notwithstanding the perceived illegality, together with a conservative approach to tourism in protected areas by conservation agencies, the concept of nature-based tourism that encompasses nudism, natourism, naturism or naturalism (hereafter referred to as 'nudism') in protected areas appears not to have been given due credence or consideration (see for example Dilsaver, 1999). As a consequence, activities such as 'nudism' have not been seriously considered as a tourism activity within protected areas in South Africa. In the absence of published information to the contrary, this observation appears to be globally relevant.

Tourism in protected areas

One of the key values of nature-based tourism is that it fosters visitors' connection with the natural

Warning sign, which may be purchased from novelty stores. Would the availability of this type of bric-a-brac reflect a growing awareness of nudist facilities?

Looking onto the informal nudist-friendly beach within the Mpenjathi Nature Reserve, KwaZulu-Natal, South Africa. © Judi Davis

environment and the biodiversity therein (Bonet-García et al., 2015; Romagosa et al., 2015). This connection, amongst other things, promotes personal rejuvenation, growth and wellbeing as well as imparting a sense of guardianship and support for the protected area. Another key benefit of nature-based tourism is the positive economic impact it has on the protected area, its neighbouring areas and beyond (Leung et al., 2018). This benefit increases with the spending potential of the visitor, which is likely to be positively correlated to the visitor's length of stay and the price of the accommodation within the protected area (Sandbrook, 2010)

From a tourism management perspective, applying a tourism use zonation reduces or ameliorates the impact tourism has on the protected area as well as reduces or eliminates the conflict that may arise from conflicting use activities (Dilsaver, 1999; Llausàs et al., 2019; Manning et al., 2012). This may be achieved using either a spatial zonation – where the conflicting activities are geographically separated, or by temporal zonation – where the conflicting activities occur at different times (Dilsaver, 1999; Rotich, 2012). For instance, hunting may solely occur within a permanently designated area (i.e. a geographical or a specific hunting zone) from which all other forms of tourism are excluded; or hunting may occur in a designated area for a specified period of the year. Outside this period, the designated hunting facilities may be used for other forms of nature-based tourism. Here, hunting is purposefully referred to in that, as with nudism, it has been actively opposed by a sector of society on both ethical and moral grounds and yet has persisted as an activity undertaken in many protected areas (de Vries, 2019; Feber et al., 2020).

The concept of tourism activity zonation is stressed on at least two fronts. The first is to set aside a portion of the protected area (either geographically or temporally) for use by a particular tourism activity, and secondly as a means to diversify the types of tourism activities that may take place in the protected area. Furthermore, it is logical (and is a legal requirement in South Africa in terms of the Regulations to the National Environmental Management: Protected Areas Act 57 of 2003, 2003) that each zoned area be managed for the purpose it was zoned and hence incompatible tourism activities would remain separated (Burns et al., 2010). Given that this zonation is founded on the dynamic equilibrium between nature-based tourism and the protection and conservation of biodiversity, it is logical that the zonation must not only be consistent with the purpose of the protected area but will also need to take into consideration: (1) the change in tourism needs as a result of evolving tourism markets, (2) changing values and expectations of society, (3) evolving philosophies on protected area governance, and (4) an improved understanding of the tolerance of the protected area, and its biodiversity, to the impacts of various tourism activities (Jones et al., 2016; McCool, 2016).

This realisation requires the conservation authority to re-evaluate the appropriateness of current tourism activities in its protected areas and to adjust its mitigation actions to reduce adverse impacts on the protected area, habitat, wildlife and other visitor experiences to an acceptable level or above a predetermined threshold which is briefly discussed below (Blackmore, 2017; Leung et al., 2018). One such example would be the phasing out of the use of lead in fishing or hunting where these activities take place in the protected area (Cromie et al., 2019; Kanstrup et al., 2018). Where more effective mitigation is not possible, halting or phasing out the tourism activity would ideally be the remedial action to be taken (Collins, 2011; Leung et al., 2018). Where the termination of a tourism activity is impossible, the residual damage caused may be offset through, for example, the expansion of the protected area by the addition of appropriate land (Blackmore, 2019). In this instance, the addition of land would compensate for or offset the damage caused to the tourism activity land (Blackmore, 2019).

Furthermore, the growth in protected area numbers has brought into play a growing choice of destinations for nature-based tourists (Adams & Moon, 2013; Crouzeilles et al., 2013). In order to remain competitive in this environment and hence financially viable, conservation authorities need to re-evaluate their marketing strategies and protected area attractiveness at regular intervals. This re-evaluation creates an opportunity to consider new or previously unconsidered tourism activities, such as nudism, that have a low potential impact on the protected area, and which may offer high beneficial returns – i.e. increased revenue (Leung et al., 2018; Shultis & Way, 2006). With an understanding of the current and emerging needs of nature-based or unexplored niche or novel markets such as nudism, a sustained tourism demand for accessing and enjoying the protected area may be achieved, or a new or alternative tourism demand may be created for protected areas – particularly for those that traditionally have a low tourism patronage. Accessing these tourism markets may require the conservation authority to facilitate, if not incentivise, the recognition of the protected area by the emerging tourism markets as a viable and attractive destination (Hausmann et al., 2017).

Tourism does have, however, a concomitant adverse impact on the integrity of the protected area and on various species and habitats therein (Steven et al., 2011). The significance of the impact varies with, inter alia, the level of disturbance caused by and/or required for the activity to be undertaken (Steven et al., 2011). Thus, selection of a tourist market should ideally gravitate to those activities that have the least impact on the protected area and its biodiversity (viz. low-impact tourism), and that generates the greatest financial and other positive benefits (Leung et al., 2018).

It is not uncommon for certain tourism activities to be seen, however, by some as: (a) incompatible with conservation and protection of biodiversity and hence incompatible with the general purpose of protected area establishment, (b) not in keeping with what is seen to be contemporary or traditional tourism activities within protected areas, (c) considered offensive in some manner or another, or (d) possibly limiting or constraining the concession given to an existing tourism activity (Diaf, 2019). When such circumstances arise (e.g. as has been the case with hunting, tourism access to wilderness, and establishment of tourism or management facilities), the protected area authority ought to apply a principled and unbiased approach to distinguish between the interests of broader society without unfair discrimination – while ensuring, among other considerations, the integrity of the protected area, biodiversity and sense of place (Smith & Csurgó, 2018). This argument is entrenched in the principle of ‘consistency of policy and action’, where a uniform and predictable outcome or decision is derived irrespective of the personal biases, values or subjective judgement of the decision-maker (Addison et al., 2013). Thus, both novel and traditional tourism activities within a protected area (e.g. nudism) must be subjected to the same set of rules to determine their permissibility. The same applies to the a priori exclusion of an existing or novel tourist activity. The consequence of this approach would be a decision that is fair, reasonable, defendable and transparent (Dovers, 2017).

A precautionary and adaptive approach

The inclusion of novel tourism activities in a protected area must be based on a reasonable understanding of the market and its requirements. Furthermore, an understanding is needed of the potential impacts of the novel tourism on the protected area and its existing tourism patronage and brand loyalty, and the feasibility of the mitigation that needs to be applied (Leung et al., 2018; Moscardo, 2008). It is, however, unlikely that the full extent of these potential impacts and the effectiveness of the required mitigation will be evident or sufficiently researched at the outset. In such cases, the conservation authority is obliged to act in a cautious and risk-averse manner, in order to safeguard the integrity of the protected area and its existing tourism (Blackmore, 2017; Leung et al., 2018).

The application of the precautionary principle (Box 2) has increasingly been used as a tool for decision-makers to avoid serious or irreversible harm – particularly in circumstances where there is uncertainty as to the nature of the risk and the consequent harm that would manifest (Trouwborst et al., 2019). Evaluating the novel tourism market operating elsewhere is likely to provide valuable insights into the degree of potential harm and associated risk that may be experienced in a protected area context. This insight, therefore, should inform the conservation authority as to whether the potential impacts are reasonably reversible, particularly if only allowed on a limited scale. Should this be the case, the novel tourism activity may be accommodated in the protected area on a 'test case' basis.

The challenge remains in determining the various limits of acceptable change, particularly within the dynamic realm of conservation and the perceptions of people. In such circumstances, and in keeping with the precautionary principle, the conservation authority may set a cautious and risk-averse 'threshold of potential concern' (TPC) prior to the introduction of a novel tourism activity such as nudism (Figure 2) (for instance, a 5 per cent reduction in traditional safari patronage).

Box 2. The Precautionary Principle
This Principle has been widely accepted since its formulation as Principle 15 of the 1992 Rio Declaration of the United Nations Conference on Environment and Development, which states:
"[i]n order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

Since then, the Precautionary Principle has evolved into many versions to suit individual circumstances (Applegate, 2002). Irrespective of the articulation of the Principle, its application remains unchanged, specifically to prevent harm to the environment (Bodansky, 2004). For the purposes of this paper, the wording of the Principle in the Rio Declaration is referred to.

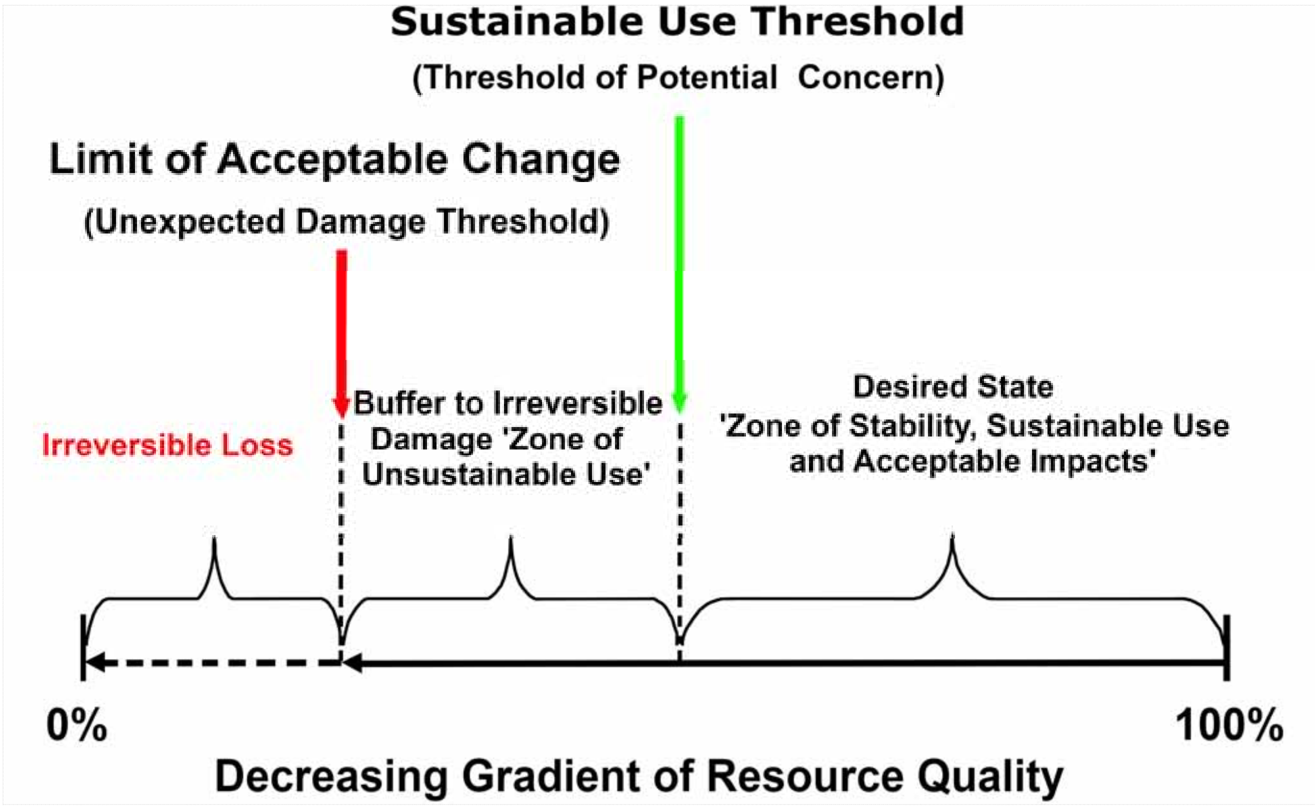

Figure 2.Diagrammatic representation of the sustainable use threshold on a diminishing resource gradient (after Blackmore, 2017)

Once the TPC has been reached, the conservation authority would be in a position to re-evaluate and adjust this threshold. The re-evaluation would be based on the monitoring of the impact of the activity on sensitive attributes or values of the protected area and management requirements. Should these impacts prove to be negligible, the TPC may be adjusted to a less cautious level, or to a stricter level should the impacts be deemed to be significant.

In this way, the precautionary principle and adaptive management would be simultaneously applied in a stepwise manner (Trouwborst et al., 2019). This approach also avoids delaying the decision until such time that there is certainty that the protected area, its biodiversity or its existing tourism patronage and brand loyalty would not be put at undue risk by a limited introduction of the novel tourism activity.

General visitor safety in protected areas

While the conservation authority has fiducial and other obligations to safeguard the protected area, it also has a duty to provide reasonable security to visiting tourists (Cerveny & Miller, 2019; Gstaettner et al., 2019). Conservation authorities generally employ law enforcement officials or rangers to patrol within and around the protected area to safeguard the integrity of the protected area and the vulnerable species (Critchlow et al., 2017; Henson et al., 2016). These patrols are primarily focused on reducing and eliminating poaching, but also serve to deter theft or damage to the protected area's infrastructure. The corollary of this patrolling and law enforcement is a secure environment for tourists to enjoy the protected area's values. Furthermore, such security is consequently greater than can reasonably be expected outside the protected area, where no such dedicated law enforcement exists. It may, therefore, be argued that this security provides the protected area with a heightened advantage to retain existing and attract novel tourism activities, when compared to neighbouring and other areas. Therefore, tourists in a protected area, and particularly those exercising an activity that renders them vulnerable to crime and harassment, like nudism, would be able to enjoy and take advantage of the security the protected area supplies.

What about nudism in protected areas?

It has been widely acknowledged that tourism, and in particular nature-based tourism in protected areas in developing countries, is one of the fastest-growing sectors of the economy (Canteiro et al., 2018; Twining-Ward et al., 2018). In the absence of evidence to the contrary, it is assumed that this assessment of the tourism industry is predominantly limited to the 'textiled' tourism sector. As a consequence, unexplored niche or novel tourism markets would not have been considered when calculating the economic potential of nature-based tourism.

View of the informal nudist beach within the Mpenjathi Nature Reserve, KwaZulu-Natal, South Africa. © Judi Davis

While there is little in the way of published research on the economic significance of nudism as a tourism activity, the International Naturist Federation (INF) have estimated their global membership (which is a collective of the national naturist societies) to be 1,450,000 members or member families (Ms Sieglinde Ivo – President of the INF, personal communication, 27 January 2020). Furthermore, an unpublished INF study estimated the global number of naturists (including INF members) to be in excess of 70 million. While this figure is small in relation to the tourism potential of Europe (i.e. 710 million international tourist arrivals in 2018), it does however represent, particularly from a protected area perspective, a significant economic market (Monterrubio & Jaurand, 2014).

In the absence of monitoring and assessment, it is difficult to determine with confidence whether nudism falls within the scope of nature-based tourism, and hence may be accommodated, at least in principle, within protected areas. The definition of nudism and activities undertaken by nudists, as popularised in the media, does, however, provide a degree of insight. Nudism is defined by the International Naturist Federation as tourists that are in "in harmony with nature", who are "characterised by the practice of communal nudity" and who have "respect for others and for the environment" (Deschenes, 2016). Others have argued that nudists are increasingly seeking the spiritual fulfilment and renewal that the natural environment provides (Andriotis, 2016). At face value, this definition and characterisation does not appear to be incongruent with a contemporary understanding of 'nature-based tourism' in protected areas. This tourism sector is generally defined as "the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (Kim et al., 2019).

The novelty of nudism in protected areas renders unknown the full extent of the possible activities that nudists would like to undertake. It is known, however, that there is an active desire for safe beaches, and this may be extended to safari tours, and dedicated accommodation and hiking trails (Dilsaver, 1999; News24, 2013). Again, particularly, when read with the definition and characterisation of nudism, other than the absence of clothing, it is difficult to objectively differentiate between the activities undertaken by nudists and those of traditional protected area visitors. Thus, it can be reasonably assumed, therefore, that existing tourism facilities or those planned for a protected area could accommodate nudism with, other than signage, little or no modifications (Blackmore, forthcoming).

However, it is recognised that there is a degree of incompatibility between a nudist-centred enjoyment of the protected area and the traditional clothed wildlife tourist. The same is argued, as discussed above, when considering the incompatibility between hunting and safari tourism. Thus, if the same rules are applied by the conservation authority to nudism as have been applied to (or derived from) their traditional tourism, it is conceivable that nudism may be accommodated in protected areas. This may be achieved through either a spatial or temporal separation of the two types of activities in a similar manner to the management of hunting in protected areas (Leung et al., 2018).

Similarly, through monitoring and evaluation, the unintended negative impacts of nudism on the protected area and its existing tourism, the feasibility of any mitigation required and the viability of the niche market, may be cautiously determined by establishing one or a limited array of nudist facilities (i.e. a nudist lodge, nudist beach and a nudist trail), within the protected area. These may be increased in number or variety using an adaptive management approach as discussed above – to a point where a portion of the protected area reasonably accommodates this activity without significantly displacing current traditional forms of tourism (Leung et al., 2018).

CONCLUSION

The objection to the formalisation of a limited nudist beach within the Mpenjathi Nature Reserve and Trafalgar Marine Protected Area, by the Concerned Citizens of the Hibiscus Coast Municipality, has provided an opportunity to consider whether nudism or partial nudism and other forms of niche tourism can be accommodated in protected areas.

With the increasing number of private, state and communal protected areas, together with the increasing dependence of these areas on the income generated from tourism, competition for tourists is likely to increase with time. Thus, in order for protected areas to remain competitive, and hence commercially viable in the long-term, it is concluded that there be greater cognisance of the sectors of the nature-based tourism market whose activities are traditionally not catered for within protected areas. This may require a revision of policies that serve to limit the types of tourism that may take place. While it is recognised that there may be significant uncertainty about what impacts a novel or previously unexplored tourism market may have on a protected area, this uncertainty may be overcome by applying a cautious and risk-averse adaptive management strategy to a limited and stepwise introduction of the tourist activity. In so doing, both indecision and serious or irreversible harm to the protected area may be avoided.

Finally, spatial or temporal zonation may be used to accommodate potentially incompatible nature-based tourism activities within a protected area, and, in so doing, broaden the tourism base the protected area is dependent upon. Consistent policy and action are, however, essential to avoid personal biases and values, subjective judgement or partisan perspectives adversely affecting the decision to move beyond traditional and existing protected area tourism.

ACKNOWLEDGEMENTS

The supportive environments of Ezemvelo KZN Wildlife and the University of KwaZulu-Natal are acknowledged with thanks.

DISCLAIMER

The ideas, arguments and opinions expressed in this article are the author's own and do not necessarily represent those of Ezemvelo KZN Wildlife or the University of KwaZulu-Natal.

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RESUMEN

La naturaleza del turismo en las áreas protegidas ha permanecido predominantemente inalterada a lo largo del tiempo. ¿Debería un nuevo enfoque con respecto a la zonificación del turismo y la recreación en las áreas protegidas incorporar un espectro más amplio de actividades turísticas basadas en la naturaleza? Utilizando el naturismo como ejemplo novedoso, esta forma de turismo podría adaptarse mediante la aplicación de la zonificación espacial y temporal de las zonas protegidas para la recreación y la infraestructura asociada. Ante la creciente dependencia de los ingresos procedentes del turismo, se concluye que se deben revisar las políticas que rigen el turismo en las áreas protegidas. Esta revisión debería ser transparente y uniforme para generar resultados o decisiones predecibles, independientemente de los sesgos personales, los valores o los juicios subjetivos de los responsables de la toma de decisiones. La incertidumbre asociada a la introducción de una actividad turística novedosa en un área protegida puede abordarse mediante la aplicación simultánea del principio de precaución y la gestión adaptable de forma limitada y gradual.

RÉSUMÉ

Le tourisme dans les aires protégées est resté essentiellement inchangé au fil du temps. Nous posons la question de savoir si une nouvelle approche du tourisme et du zonage récréatif dans les aires protégées devrait intégrer un plus large éventail d'activités touristiques axées sur la nature. En tant que nouveau genre de tourisme, le naturisme pourra s’adapter aux aires protégées et aux installations associées en y appliquant un zonage récréatif et temporel. Face à leur dépendance croissante à l’égard des recettes touristiques, nous concluons qu’une révision des politiques régissant le tourisme dans les aires protégées serait nécessaire. Cette révision doit être transparente et uniforme afin de générer des décisions et des résultats prévisibles, quels que soient les inclinaisons personnelles, les valeurs ou les jugements subjectifs des décideurs. L'incertitude associée à l'introduction d'une nouvelle activité touristique dans une aire protégée serait résorbée en appliquant simultanément le principe de précaution et la gestion adaptative d'une manière limitée et par étapes.

LESSONS AND SURPRISES FROM AN INTER-ISLAND RE-INTRODUCTION OF THE CRITICALLY ENDANGERED RASO LARK *ALAUDA RAZAE* OF CAPE VERDE

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ABSTRACT
Confined to a single island where its small population fluctuates in response to rainfall, the Raso lark is likely to remain Critically Endangered unless a second population becomes established. This paper reports translocations of larks, 37 in 2018 and 33 in 2019, to the nearby island of Santa Luzia where the species existed until about 500 years ago. Both islands lie within the Reserva Natural Integral de Santa Luzia. While the hard release protocol proceeded without mishap, problems with radio-tagging the released birds were encountered. However early indications are encouraging; the released birds have bred, and their annual survival is not substantially worse than that of larks on the source island, Raso. Unexpectedly, the study documented several natural, unassisted movements of larks from Raso to Santa Luzia (and, less unexpectedly, of translocated birds returning to Raso). The ultimate outcome of the project remains uncertain since eradication of Santa Luzia's introduced cats, possible predators of the larks, was interrupted when the island was evacuated because of the Covid-19 pandemic.

Key words: island restoration, threatened species, population growth, immigration, hard release, radio tagging, Reserva Natural Integral

INTRODUCTION
Since its scientific description (Alexander, 1898), the Raso lark *Alauda razae* has been confined to the 7 km² islet of Raso, the largest island in the Cape Verde archipelago that has never been permanently inhabited by people. Although smaller than its sister species, the Eurasian skylark *A. arvensis* (Dierickx, 2018), the Raso lark, typically 18–22 g, shows dietary similarities; while invertebrates are delivered to nestlings, the diet of non-breeding birds is principally plant material, including seeds, gleaned from the barren plains of Raso (Donald & Brooke, 2006). There the species' population fluctuated between about 20 and 130 pairs during the second half of the 20th century (Donald et al., 2003). From 2001–2019, annual monitoring has continued to document fluctuation from a low of 57 individuals in 2004 to between 900 and 1,550 individuals from 2011–2019 (Brooke, 2019, pers. obs.). These fluctuations have been driven largely or entirely by rainfall; after rain birds breed and the population increases rapidly, but periodic long droughts can cause the population to sink to very low levels (Brooke et al., 2012; Brooke, 2018 Dierickx et al., 2019). Confined to a single island and with a population that fluctuates greatly and is often below 100 individuals, the species is classified as Critically Endangered and, given its single island status and small population, will almost certainly remain so in the absence of active conservation intervention. Translocating a portion of a threatened population to a new locality is a common conservation action (Fischer & Lindenmayer, 2000) and is the most obvious candidate intervention in the case of the Raso lark. With annual

survival exceeding 80% (Dierickx et al., 2019), which is high for a small passerine, the lark has a life history that is associated with successful translocations (Ducatez & Shine, 2019).

Subfossil studies have revealed that the lark previously occurred on three other Cape Verde islands, São Vicente, Santo Antão and Santa Luzia (Figure 1; Mateo et al., 2009). The species' disappearance from those islands occurred at roughly the time the archipelago was permanently settled by people in the mid-fifteenth century, and was presumably caused by the habitat changes and introduction of alien species arising from settlement. Of the three islands, São Vicente and Santo Antão retain substantial human populations and have never been seriously considered for a lark re-introduction. The focus has been on 35-km² Santa Luzia, 16 km at the nearest from Raso. Both islands lie within the Reserva Natural Integral de Santa Luzia and have similar habitat. Whilst Raso has never been inhabited and has no mammals, Santa Luzia was inhabited in the past and is occupied by two species of non-native mammal, cats *Felis catus* and mice *Mus musculus*. Today neither island supports permanent human habitation but both receive frequent overnight visits from fishermen.

The possibility of a lark re-introduction to Santa Luzia was first considered around 2008 when the Raso population had increased from its 2004 low point to around 200 birds. A serious worry was the possibility that the cats on Santa Luzia would kill the larks soon after their release there. This triggered discussion about whether a reintroduction at this time would be contrary to the IUCN (2013) guidelines which stipulate that "There should be confidence that these past causes [of local population extinction] would not again be threats to any prospective translocated populations". However, it was evidently impossible to establish that cats were actually responsible for the larks' disappearance 500 years in the past, especially as another lark species, the bar-tailed lark *Ammomanes cinctura*, has persisted alongside cats on Santa Luzia, albeit in small numbers. On the other hand, the alternative argument was made that any such project would, at the worst, likely provide methodological lessons that could prove useful in the

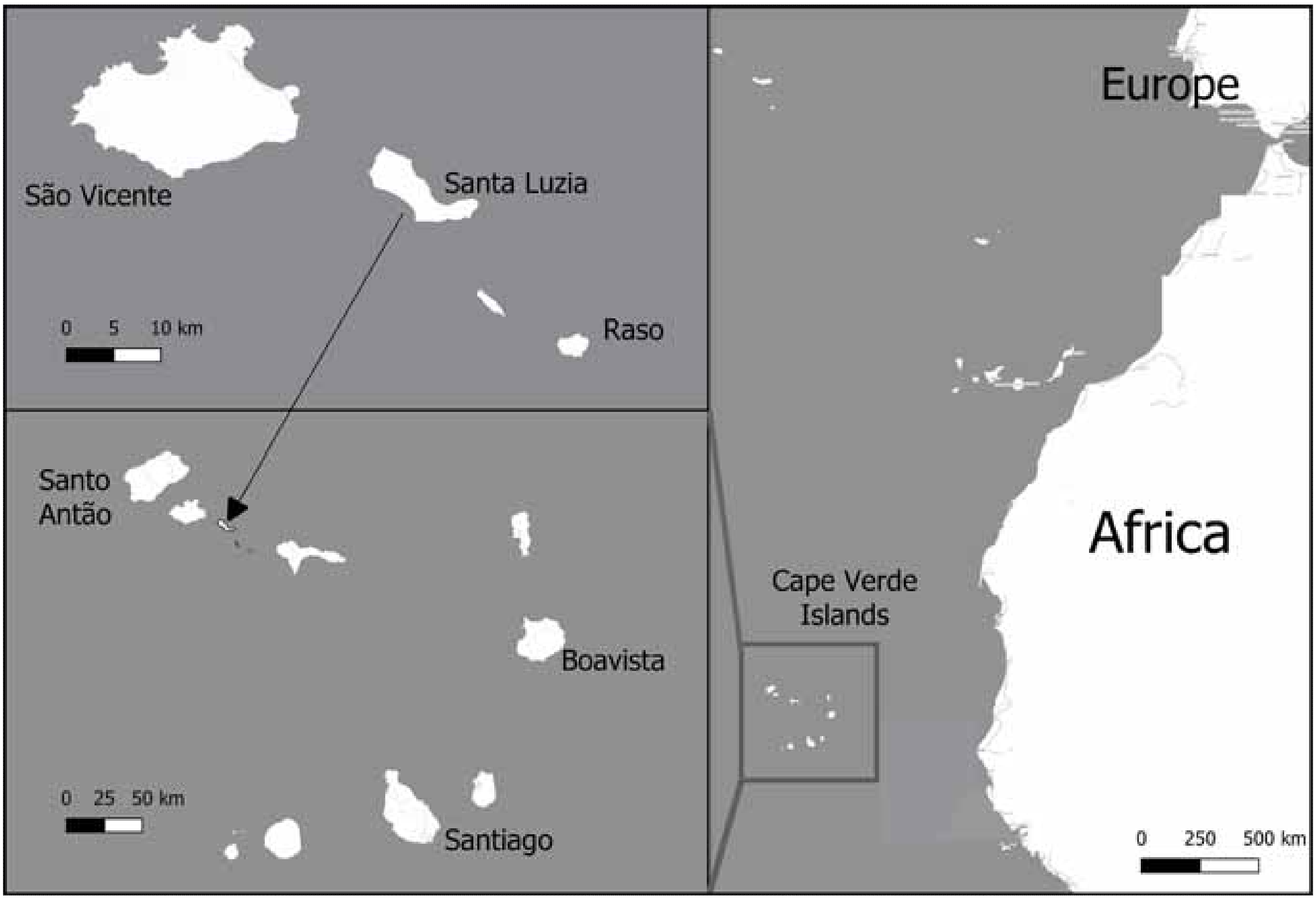

Figure 1. The geographical position of the Cape Verde archipelago, including the islands of Raso and Santa Luzia

A recently-released colour-ringed Raso lark on Santa Luzia, showing the protruding radio antenna ©Paul Donald

future. This would be within the spirit of the IUCN guidelines "where significant uncertainty exists, an experimental approach within the translocation programme can provide guidance for implementation". Moreover, the Raso population, at that time around 200 and with a strongly male-skewed sex ratio (Brooke et al., 2012), could arguably 'spare' males to provide the lessons.

There matters rested until the Raso lark population frequently exceeded 1,000 post-2011, and a grant was awarded in 2017 to SPEA (Sociedade Portuguesa para o Estudo das Aves or Portuguese Society for the Study of Birds, the BirdLife Partner in Portugal) by the MAVA Foundation for ecological restoration of Santa Luzia. Key components of this wide-ranging restoration project would be the eradication of cats from Santa Luzia and translocation there of larks from Raso. The question then was whether to embark on translocation while cat eradication was still in progress, albeit with cat numbers much reduced, or to delay until total eradication. A decision in favour of the former was made and plans drawn up for the first translocation in April 2018, when cat numbers were reduced by approximately 50%, to a density under two per square kilometre (Geraldes et al., 2016). The proposed lark translocation therefore followed in the footsteps of other passerine translocations undertaken elsewhere, for example in New Zealand (Armstrong & Craig, 1995; Armstrong & Ewen, 2001), the Seychelles (Wright et al., 2014) and the Hawaiian Islands[1]. In all cases, the aim was to establish additional populations of island species existing in limited numbers on one or a few small islands (Taylor et al., 2017).

PLANNING THE TRANSLOCATION

April was chosen as the translocation month, partly because of the availability of key personnel but also for biological reasons. It was a time of year when Raso larks were unlikely to be breeding (the main breeding season is between September and December; Donald & Brooke, 2006). Thus there was minimal risk that birds would inadvertently be removed from parental duties, with fatal consequences for eggs or chicks. Furthermore, it was assumed they would be minimally motivated to return from Santa Luzia to breeding territories. In fact such motivation may be lowest in newly-independent juveniles, but catching such juveniles in reasonable numbers after a period of successful breeding, a period that could not be predicted in advance, was unrealistic. Furthermore, the distinctive juvenile plumage is soon moulted out, after which young birds become indistinguishable from adults even in the hand.

For the first translocation, in 2018, the intention was to move 30–40 birds from Raso to Santa Luzia, a total at the lower end of the range suggested by Tracy et al. (2011) if the aim was to ensure the genetic diversity of the donor population was retained in the newly-established population. However, this total was partly determined by the likely number of birds that could be caught each day, and the number of days that a boat could remain on station to effect the transfers to Santa Luzia. The total number of birds removed from the Raso population was therefore unlikely to impact the long-term trajectory of the population since it was currently quite large (Bain & French, 2009), exceeding 1,500 birds.

Birds would be caught from 15:30 (local time) onwards, a timing that would deprive each bird of at most 2.5 hours of late afternoon feeding. They would be retained individually overnight in large cloth bird bags, transferred by boat overnight or early the following morning to Santa Luzia, and then released as soon as possible after dawn. This would be a 'hard' release with no pre-release familiarisation to the novel Santa Luzia environment, no anti-predator training, and no provision of supplementary food and water. In the absence of any contra-indications, this release protocol was chosen simply because it was logistically the easiest and also the least costly; in the event (see below), it proved entirely satisfactory.

PROGRESS IN THE FIELD

Translocation in 2018

As anticipated, Raso was dry when we arrived on 11 April 2018, and there were no signs of lark breeding activity. Most birds were in heavy wing moult, indicating that breeding had ceased since larks in this genus have only a single post-breeding annual moult. Furthermore, most birds were gathered in roving flocks of 30–200 individuals, a further indication that little or no breeding was taking place. These flocks are difficult to approach closely, and larks correspondingly difficult to catch. It quickly became evident that the best prospects for catching birds were offered by the area close to the camp (and principal landing) where feeding birds dig into the ground (Donald et al., 2007), especially in the late afternoon which, conveniently, was the designated catching period.

During the course of the first catching session (14 April), we learnt that the birds in the digging area were mostly male (7 males and 1 female caught). On subsequent evenings, we deliberately attempted to target the smaller-billed females but the catch remained male-biased (Table 1). Each bird captured was measured, blood-sampled and given both a metal ring and a unique colour-ring combination. Every combination included a colour, pale blue, that was never used on Raso among the approximately 1,000 colour ring combinations used there since 2002 (Dierickx et al., 2019), meaning that it would be possible, at a glance, to identify any bird returning from Santa Luzia to Raso.

Each day's batch of birds was taken aboard the Biosfera vessel, *Jairo Mora Sandoval*, at dusk without incident. The birds were then roosted overnight in suspended bird bags in a quiet dark room aboard the vessel which set forth to Santa Luzia at dawn the following morning. No food or water was provided.

On arrival at Santa Luzia, birds were taken ashore immediately, and ferried in their bags to the release point (Figure 2). On the first two days, radio tags (Biotrack PicoPip 392) were glued to a patch of skin on the back of all 12 birds immediately prior to release to facilitate tracking the birds and assessment of their habitat use. Then the day's batch of birds was released simultaneously.

Four and a half hours after the first release on 15 April, a headless lark and another tag with many feathers plucked were found near the release point where a neglected kestrel *Falco (tinnunculus) neglectus* was in residence. On the second release day, birds were released in a different area (Figure 2) but again some birds were predated. It was thought that a single pair of kestrels, nesting on a cliff less than 1 km from the initial release site, was responsible for all these predations. Although predation by kestrels of larks was not seen, there was plenty of evidence that kestrels were responsible for the rapid disappearance of tagged larks. On one occasion, researchers spent several hours tracking a tag before realising that the signals were coming from a kestrel, which had presumably ingested the tag. Tag signals were also detected coming from the kestrel nest, indicating that larks had been taken there. In due course, evidence emerged from whole or partial corpses that kestrels killed at least six of the 12 birds released on the first two days. Although kestrels also occur on Raso, the fact that the Santa Luzia kestrels had chicks in the nest and the larks' lack of familiarity with their new environment may have contributed to the predation. Furthermore, although the tags themselves were hidden under the larks' back feathers, the black protruding antennae often glinted in the sunlight and may have attracted the kestrels, as researchers following the birds could clearly see the reflections from a distance.

On subsequent days, the remaining 25 birds were released without radio tags, due to concerns that the

Table 1. Details of Raso larks caught on Raso and taken to Santa Luzia where they were released as specified

Date caught on Raso	No. males	No. females	Time of release on Santa Luzia next morning	Release square (see Fig. 2)	Release comments
14	7	1	08:35	F5	Radio-tagged
15	2	2	11:06	F4	Radio-tagged
16	6	2	10:40	D1	Not radio-tagged
17	5	2	10:00	D1	Not radio-tagged
18	4	3	10:30	E2	Not radio-tagged
19	1	2	10:40	E2	Not radio-tagged
Totals	25	12			

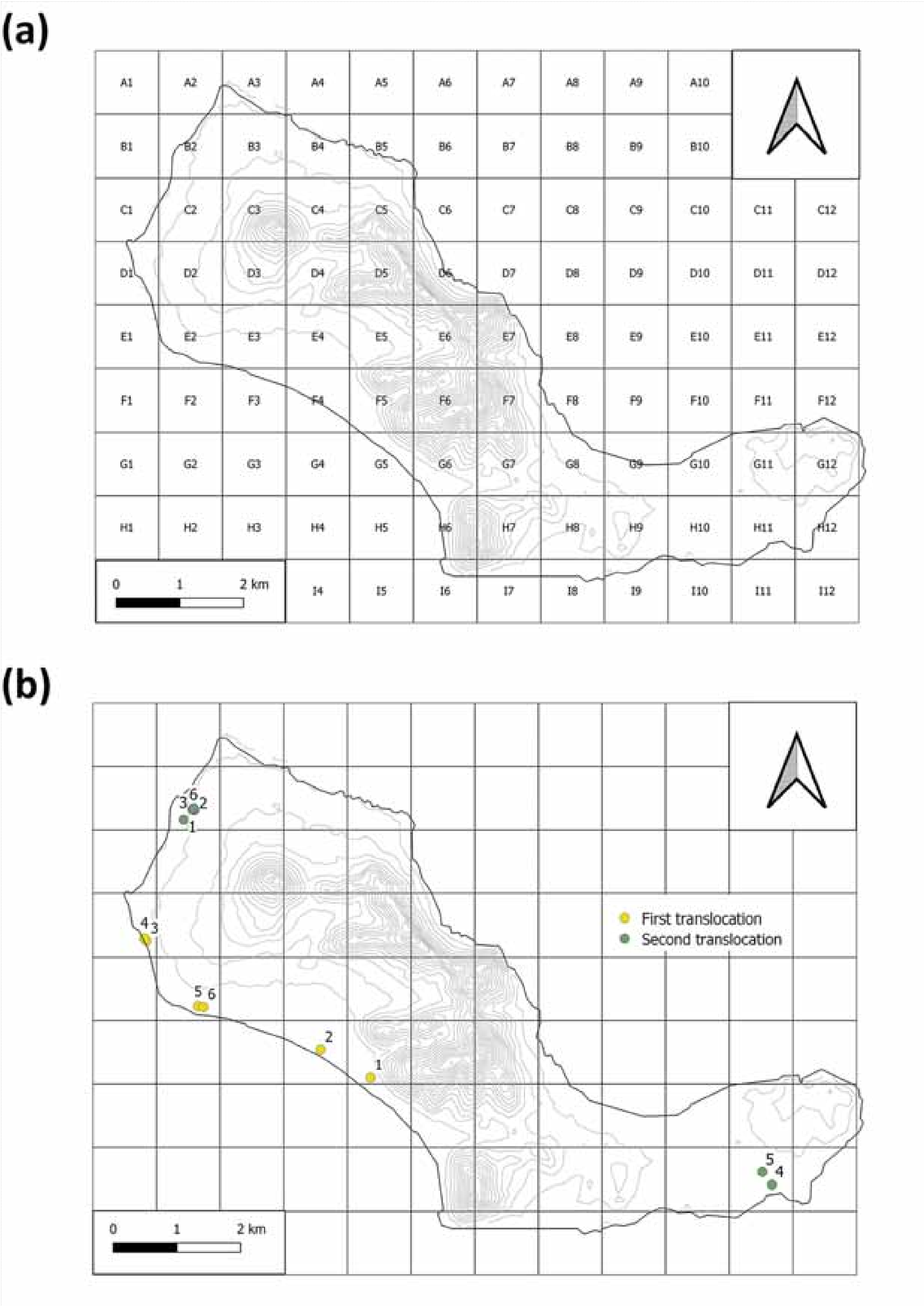

Figure 2. (a) Base map showing 1-km grid squares referred to in text and tables and (b) points where Raso larks were released over six days (1–6) in 2018 (yellow) and 2019 (green)

antennae were contributing to predation. The events associated with radio-tagging exemplify how translocation projects can be disrupted by events wholly unanticipated during planning.

Following the problems with radio tags, it was possible to use the tags to follow only two birds on Santa Luzia into May beyond the initial post-release days. Both moved 2–3 km from the release sites (F4 and F5; Figure 2) to the north-west (E2), with no indication of excursions to other parts of the island.

Observations made over the following seven months indicated that the birds remaining on Santa Luzia were mostly seen in the north-west (B2 and C2) and south-east (H11), with one bird known to have visited both areas. The decline in the number of translocated birds on Santa Luzia (Figure 3) was faster than would have occurred if Santa Luzia birds experienced an annual survival of 82 percent, the average rate on Raso (Dierickx et al., 2019).

In addition to death, numbers may have diminished due to emigration; one bird, a male, released on Santa Luzia on 16 April and last seen on that island on 21 September, was sighted back on Raso in mid-November in the exact area where it had been caught. Conversely, the Santa Luzia population was supplemented by natural unassisted immigration; a female, colour-ringed on Raso in November 2017, was sighted on Santa Luzia in October 2018.

The translocated birds that survived had apparently adapted to the Santa Luzia environment as evidenced by breeding; a young fledgling was seen in the north-west (Square E2) in July, well before the first signs of breeding activity on Raso, in September. In addition, the natural immigrant female mentioned in the previous paragraph bred with a translocated male in the south-east of the island (Square H11). Although no nest was found, three recently fledged young were seen.

The overall population trajectory resulting from the first translocation, the combination of translocated birds, immigration and successful breeding, is shown in Figure 3. Total numbers could be somewhat underestimated since Santa Luzia is sufficiently large that some Raso larks present could easily escape detection.

A supplementary translocation?

At the start of 2019, at least 12 Raso larks remained on Santa Luzia, prompting the question: Would it be wise to top-up the population in the near future? Arguments for and against such a course of action were as follows:

In favour of an early second top-up translocation

- The small population on Santa Luzia was demographically vulnerable and possibly genetically impoverished,

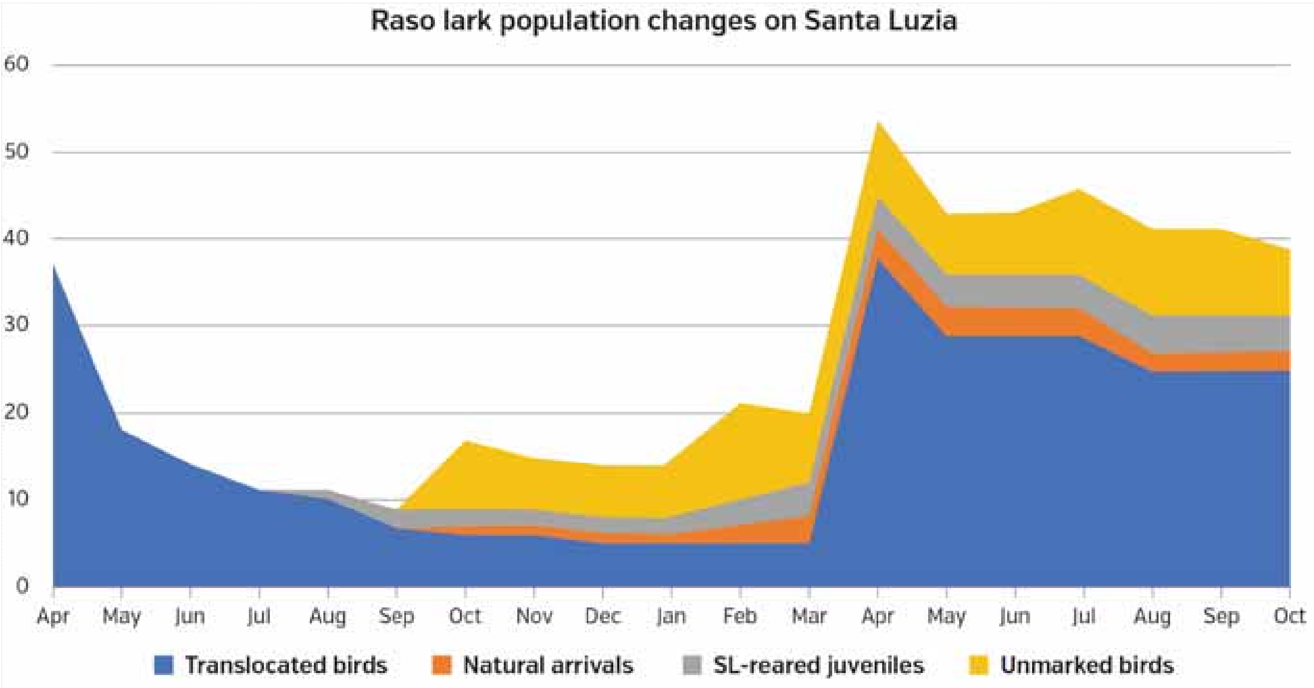

Figure 3. Minimum numbers of Raso larks on Santa Luzia from April 2018 until October 2019

- The distribution of the larks already present on Santa Luzia indicated the best habitats and safest release locations for newly-translocated birds, possibly reducing short-term post-translocation mortality,
- The Raso population, which at the time was high (ca. 1,500 birds), could withstand removal of further birds.

In favour of delaying a second top-up translocation

- A further top-up translocation would involve time, effort and expense
- Knowing now that larks can fly between islands in both directions, further colonists could arrive on Santa Luzia and naturally boost the population,
- The Raso population can multiply 5-fold following a couple of rainy years (Brooke et al., 2012). A similar increase by Santa Luzia's population would render a further translocation unnecessary,
- Given the unexpectedly high genome-wide variation among Raso larks (Dierickx et al., 2020), the birds on Santa Luzia were likely to be genetically variable,
- Cats (< 10) were still present on Santa Luzia. It would make sense to delay any top-up translocation until they had been totally eradicated.

These arguments were presented in January 2019 to approximately 20 conservation practitioners working at the David Attenborough Building, University of Cambridge. Noting especially the small size of the Santa Luzia population, approximately 80 per cent of the group favoured an early second translocation, plans for which were duly instigated. At this stage two more

Transporting the larks, suspended in bird bags in water-resistant blue plastic bin, from Raso to the dinghy and thence the larger inter-island vessel ©Laura Castello colour-ringed females from Raso, also ringed there in 2017, were sighted on Santa Luzia, one in February and one in April 2019. Thus three colour-ringed females are known to have moved naturally from Raso to Santa Luzia. This hint of female-biased natural dispersal in the Raso lark matches the widespread pattern of female-biased dispersal observed among birds (Greenwood, 1980). Since the proportion of all birds on Raso that were colour-ringed was about one-third, it may be that the total number of natural movements to Santa Luzia in the year to April 2019 was 8–10.

Translocation in 2019

Once again Raso was dry when the catching team arrived in late March 2019, and there were no signs of lark breeding activity. With most birds in unapproachable flocks, we again largely caught birds in the area close to the camp where birds dig into the ground for food, especially in the late afternoon. Some birds were attracted to the net by water and/or biscuit crumbs, a ploy which helped us assess a bird's sex before it was caught, and so avoid catching a large excess of males which, as in 2018, were the more numerous in the camp area (Table 2). Birds were measured, blood-sampled and given both a metal ring and a unique colour-ring combination. As in 2018, every combination included a pale blue ring, never used on Raso.

The transport and release protocol was identical to that pioneered in 2018. No food or water was provided, and no birds were radio-tagged. As indicated in Table 2, 22 birds were released in the north-west of Santa Luzia near the Agua Doce lighthouse (B2: Figure 2) and 11 in the Francisca area in the south-east (H11: Figure 2). These two areas were selected since they were the focus of activity of the roughly 20 birds already present on Santa Luzia, and therefore presumably offered the most suitable habitat.

By the end of April 2019, 18 of the 33 released birds had been seen at least once between one and 13 days after release. All detected birds were seen either in the release square or one square away. Monitoring was intermittent in May–September but more intensive in October–November when 20 of the 33 birds released in 2019 were sighted on Santa Luzia. Since a further three (see below) are known to have returned to Raso, survival of the larks translocated in 2019 was clearly higher than in 2018, because immediate kestrel predation was largely or wholly avoided and perhaps also because birds were released in the areas known to be preferred where they joined other birds already present.

Table 2. Details of Raso larks caught on Raso in 2019 and taken to Santa Luzia where they were released in the area specified, in all cases no later than 10:00 on the day after capture

Date caught on Raso	No. males	No. females	Release square (see Fig. 2)
28 March	5	1	B2
29 March	3	4	B2
30 March	3	3	B2
31 March	5	1	H11
1 April	2	3	H11
2 April	1	2	B2
Totals	19	14	

In October 2019, the minimum Santa Luzia population was about 40–50 individuals, comprising five and 20 from the 2018 and 2019 translocations respectively, two colour-ringed natural immigrants and about 15 unringed birds. This latter group probably included both birds raised on Santa Luzia (a minimum of four: Figure 3) and unringed unassisted immigrants from Raso.

Although recently-fledged juveniles seen in 2018 had provided conclusive evidence of successful breeding on Santa Luzia, it was not until November 2019 that two nests were found, both in square B2. One nest had a single egg that did not hatch, the other had a single egg that did not hatch plus a chick that successfully fledged.

Birds returning to Raso

Following the single bird known to have returned to Raso from the 2018 releases, three birds translocated to Santa Luzia in March/April 2019 had returned to Raso by the time of the annual November monitoring visit. These included two males caught near our camp. This was exactly the area to which they returned, and both were actively breeding in November (nests found). The third was a female which was caught about 800 m north of the camp. She too returned from Santa Luzia to her capture area, but we obtained no evidence she was breeding.

More remarkable was a non-translocated female ringed on Raso in November 2017. She was then observed in square H11 in the south-east of Santa Luzia on several dates between 25 October 2018 and 13 February 2019 during which period she bred successfully (see above), before returning to Raso. There she was observed in

Releasing Raso larks on Santa Luzia ©Jesús Martinez

November 2019 in Cha da Castelo around 500 m east of the original ringing location.

2020 UPDATE AND CONCLUDING OBSERVATIONS

The Raso lark has shown itself tolerant of a hard release protocol. However, the project outcome remains uncertain since the 2020 coronavirus crisis led to the evacuation of all project personnel in late March. Intermittent work began again on the island in late May. This chain of events has reduced the chance that the remaining cats, believed to number at most six, will be eradicated in 2020. Since there is every likelihood that those remaining cats include both males and females, the population will probably rebound. Although neither planned nor desired, this chain of events does potentially provide an experimental test of whether Raso larks can persist alongside cats. Since evidence accumulated by the project suggests Santa Luzia is suitable for Raso larks, those larks present in early 2020, supplemented by any further immigrants from Raso, may establish a viable long-term population if the impact of cats proves to be slight. On the other hand, if the lark population disappears, particularly once the cat population grows, the prudent course may be to delay a further translocation until cats have been totally eradicated from Santa Luzia.

While the return of some translocated birds to Raso across 16 km of sea was not unexpected, Raso larks had never been seen on Santa Luzia prior to this project. Therefore the unassisted movements of three colour-ringed birds from Raso to Santa Luzia was not anticipated, even allowing for the single 2009 sighting of a Raso lark on Sao Nicolau some 20 km to the east of Raso (Hazevoet, 2012). Although greater observer effort on Santa Luzia of course increases the chance of seeing visiting larks, it seems probable that larks have been visiting Santa Luzia for years, but only sighted recently. This could be because the visiting larks were not killed by cats in 2018 and 2019, and therefore survived to be seen, and/or it could be that the presence of translocated larks has provided sufficient social attraction to prompt any arriving immigrants to linger.

To our knowledge, possible social attraction has not been recorded in other passerine translocation projects. For example, the Seychelles warbler *Acrocephalus sechellensis*, now with a global population of about 3,000 birds[2], has been translocated from Ile Cousin to four other islands, in some cases across sea distances under 10 km (Wright et al., 2014). Only six cases of inter-island dispersal have been documented in this large project (Hannah Dugdale, in litt.). On the other hand, the rapidity with which some seabird populations grow after removal of mammals implies visitation by prospecting pre-breeders (Brooke et al., 2018), as does the success of some seabird attraction projects involving model seabirds and/or acoustic cues (Jones & Kress, 2012). If social attraction is a factor influencing the success of other avian re-introduction projects, it argues for reintroductions to be as near to the source population as practical.

ENDNOTES

[1]https://pacificrimconservation.org/conservation/bird-translocations/

[2]http://datazone.birdlife.org/species/factsheet/seychelles-warbler-acrocephalus-sechellensis/text

ACKNOWLEDGEMENTS

We gratefully acknowledge financial support from the MAVA Foundation. The captains of the Jairo Mora Sandoval, Ivan Pires in 2018 and José Melo in 2019, provided crucial and willing assistance as did all the Biosfera 1 team on Santa Luzia. The translocations were authorized by DNA – National Environmental Agency – Cabo Verde. The comments of two anonymous referees improved the clarity of the text.

STOP PRESS LATE OCTOBER 2020

Although Covid-19 restrictions will preclude the detailed annual monitoring on Raso in November 2020, the news from Santa Luzia is positive. Regular monitoring throughout the island has detected no further sign of cats since mid-July. Seven pairs of Raso larks were known to be actively breeding (five nests plus two pairs feeding juveniles) in October 2020. Furthermore, early indications suggest that populations of native reptiles and other landbirds have increased.

ABOUT THE AUTHORS

Michael Brooke, a member of Cambridge University's Zoology Department, has maintained the long-term Raso lark study with annual visits from 2002 to the present. He also has a long-standing interest in seabirds and island restoration, particularly via the removal of alien mammals.

Lee Gregory has had a lifelong obsession with Western Palearctic birds. An accomplished rare bird finder with four national firsts to his name in the Canary Islands, Cape Verde, Gambia and Kuwait, Lee was formerly Assistant Warden at Fair Isle and Dungeness Bird Observatories. A qualified British Trust for Ornithology bird ringer, he is currently working in Primary School Education in South Wales as a site manager.

Pedro Geraldes is a biologist and certified ringer who has dedicated his career to the recovery of threatened species and habitats, mainly with seabirds and invasive species. Working for SPEA since 2004 he has participated in and coordinated several conservation projects with strong public visibility and local stakeholders' involvement. Since 2012 he has managed projects on the marine reserve of Santa Luzia, together with the local NGO Biosfera I.

Laura Castelló graduated in Biology at the University of Valencia (Spain). Following an Erasmus exchange visit to the Faculty of Sciences of Lisbon, she did an internship at Madeira Natural Park in the LIFE Ilhéus do Porto Santo project. In March 2012 she started her collaboration with SPEA Madeira as a volunteer within the European Voluntary Service, and from October 2013, as a conservation officer in several projects. In 2018 she collaborated for seven months on the conservation project in the Santa Luzia Reserve, Cape Verde.

Paul Donald is Senior Scientist at BirdLife International and Honorary Research Fellow at the University of Cambridge. He has a particular interest in larks and has worked on all the world's rarest species.

Tommy Melo is a biologist, dedicated to the conservation of species and habitats, especially the creation and sustainable management of marine protected areas in Cape Verde. He is a co-founder of the Cape Verdean NGO Biosfera 1 for the conservation of nature, and its President since 2014.

Joana Bores developed a passion for island conservation in 2011 when she built a Cory's shearwater artificial nest on Berlengas Island (Portugal). She then decided to study Marine Biology and dedicate herself to the recovery of species and islands. She has been working in SPEA since 2016 on different island restoration projects, and since 2018 has been responsible for Raso lark monitoring on Santa Luzia.

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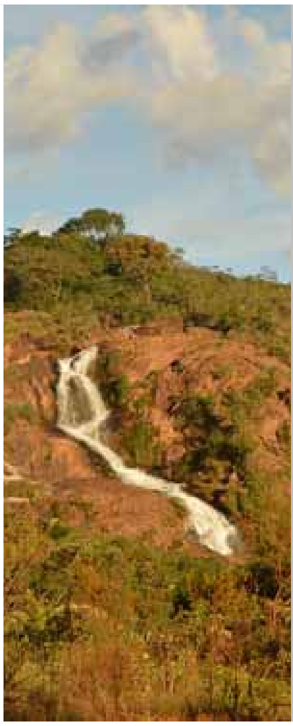
RESUMEN
Confinada a una sola isla donde su pequeña población fluctúa en respuesta a las precipitaciones, es probable que la alondra de Raso permanezca En Peligro Crítico a menos que se establezca una segunda población. Este artículo informa sobre la translocación de alondras, 37 en 2018 y 33 en 2019, a la cercana isla de Santa Luzia donde la especie existió hasta hace unos 500 años. Ambas islas se encuentran dentro de la Reserva Natural Integral de Santa Luzia. Aunque el protocolo de liberación procedió sin contratiempos, surgieron problemas con el marcaje por radiofrecuencia de las aves liberadas. Sin embargo, los primeros indicios son alentadores; las aves liberadas se han reproducido y su supervivencia anual no es sustancialmente peor que la de las alondras en la isla de origen, Raso. De forma inesperada el estudio documentó varios movimientos naturales, no asistidos, de alondras de Raso a Santa Luzia (y, menos inesperadamente, de aves translocadas que regresaban a Raso). El resultado final del proyecto sigue siendo incierto, toda vez que la erradicación de los gatos introducidos de Santa Luzia, posibles depredadores de las alondras, se vio interrumpida cuando la isla fue evacuada a causa de la pandemia de Covid-19.

RÉSUMÉ
Confinée à une seule île où sa faible population fluctue en réponse aux précipitations, l'alouette Raso est susceptible de rester en danger critique d'extinction à moins qu'une deuxième population ne s'établisse. Cet article fait état des translocations d'alouettes, 37 en 2018 et 33 en 2019, vers l'île voisine de Santa Luzia où l'espèce existait jusqu'à il y a environ 500 ans. Les deux îles se trouvent dans la Réserve Naturelle Intégrale de Santa Luzia. Alors que le protocole de libération dure s'est déroulé sans incident, des problèmes de marquage radio des oiseaux relâchés ont été rencontrés. Cependant, les premières indications sont encourageantes; les oiseaux relâchés se sont reproduits et leur survie annuelle n'est pas sensiblement pire que celle des alouettes sur l'île source, Raso. De manière inattendue, l'étude a documenté plusieurs mouvements naturels et non assistés d'alouettes de Raso à Santa Luzia (et, de manière moins inattendue, d'oiseaux transférés retournant à Raso). L'issue finale du projet reste incertaine car l'éradication des chats non-indigènes à Santa Luzia, prédateurs potentiels des alouettes, a été interrompue lorsque l'île a été évacuée en raison de la pandémie de Covid-19.



COLLAPSE OF NATIONAL PROTECTED AREAS IN BRAZIL: THE EXAMPLE OF MINAS GERAIS STATE

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ABSTRACT
Historically, Brazil has played a prominent role as a member of the Convention on Biological Diversity and as a signatory to the Paris Agreement on Climate Change and several other international environmental agreements. Aiming to evaluate the management of investment in protected areas during the past 12 years, we have analysed the annual budgets of National Protected Areas located in Minas Gerais. This state comprises three different biomes, including two hotspots. In all years, investments in sustainable use units were substantially lower than in areas of integral protection. For both groups, investments were particularly low in 2019, around 74 per cent lower than in 2018. Although we cannot say that this is a future trend, the current crisis in Brazil and the world leads us to believe that protected areas may be compromised if these areas are not adequately valued as sources of socio-environmental health.

Key words: budget cuts, ecosystem services, environmental conservation, environmental legislation, public policy, biological conservation

INTRODUCTION
In Brazil, 334 National Protected Areas have been created since 1937, and managed by the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) with the main objective to protect areas with high biotic and abiotic value and, following the creation of the Conservation Units National System (SNUC), to also valorise their cultural and social aspects.

However, the effective implementation of these protected areas still faces several challenges, such as the lack of basic infrastructure, insufficient employees and land regularisation issues (Medeiros et al., 2011). Although the simple act of protected area creation and implementation has positive effects on habitat loss reduction (Geldmann et al., 2013) and avoiding deforestation (Nolte et al., 2013), inadequate financial support limits its management effectiveness (Bruner et al., 2004; Medeiros et al., 2011).

Recent studies have demonstrated the great economic benefits of the protected areas network in Brazil, especially considering the tourism sector, which is responsible for generating an estimated R$2.5 to 6.1 billion[1] in revenue and 77,000 to 133,000 jobs in 2016 (Young & Medeiros, 2018). Protected areas are also important in climate change mitigation (Ricketts et al., 2010). For Brazilian protected areas, Young and Medeiros (2018) conservatively valued carbon stock services at R$130.3 billion, with annual benefits ranging from R$3.9 to R$7.8 billion due to avoided deforestation. They also calculated the annual contribution of Brazilian protected areas to the maintenance of water resources (R$59.8 billion), a monetary amount attributed to river protection for hydroelectric generation (the largest Brazilian energy source worth R$23.6 billion), erosion prevention (R$7.8 billion) and consumptive uses (irrigation, industry and human supplies, R$28.4 billion). These data, associated with the fact that for each R$1 invested in the protected area system, R$7 was generated in economic benefits (Souza et al., 2017), evidence that allocating financial resources for the maintenance, expansion and improvement of protected areas cannot be considered as an expense, but as an excellent investment with considerable socio-economic benefits (Gantioler et al., 2010; Young & Medeiros, 2018).

Despite the undoubted socio-economic and environmental importance of protected areas, political movements in recent years have threatened this global biodiversity heritage. Events of protected area downgrading and downsizing have become more common in Brazil (Bernard et al., 2014), and a recent bill proposal even aims to repeal the newly created protected areas that have problems related to land tenure just five years after their creation (Silveira et al., 2018). Other bill proposals aim to weaken and alter the national environmental licensing system (Fearnside, 2016), while constant budget cuts are occurring in biodiversity conservation science (Magnusson et al., 2018). In addition, the current Brazilian Environment Ministry (MMA) has adopted measures that reduce the transparency of the Instituto Brasileiro do Meio Ambiente e dos Resursos Naturais Renováveis (IBAMA) and ICMBio, the largest federal agencies working on environmental management, crime investigation and preservation (Moraes, 2019).

Considering this scenario of serious setbacks in the Brazilian environmental agenda, we analysed the annual budgets for each of the National Protected Areas of Minas Gerais State from 2008 to 2019 to design possible solutions that may contribute to meeting the current financial challenge of maintaining appropriate management of these areas.

METHODS

We selected Minas Gerais (territorial area: 586,528 km^2) due to its importance in the Brazilian environmental context, containing two world biodiversity hotspots, the Cerrado and Atlantic Forest (Mittermeier et al., 2004), as well as Caatinga, a biome where conservation actions have been lacking, and which is being threatened by habitat and biodiversity loss (Silva et al., 2017). Minas Gerais also has a unique ecosystem called *campos rupestres*, which is highly threatened by mining activities, especially in its ferruginous geosystems, which have a high rate of endemism and maintain large water reserves (Gama & Matias, 2015; Silveira et al., 2016; Carmo et al., 2018). Minas Gerais currently has 18 National Protected Areas implemented by the SNUC (Figure 1) with a total area of 1,573,662 hectares that protect, among other areas, watersheds of great national importance, such as the Rio Doce and Rio São Francisco basins, both recently impacted by major mining disasters (Carmo et al., 2017; Cionek et al., 2019; Santos et al., 2019).

For our analysis, we used only official data from government agencies: public data obtained on the website of the federal environmental agency (ICMBio), or requested through the Brazilian Law on Access to Public Information (Brasil, 2011). These data represent the financial amount allocated through Annual Budget Law (LOA) for each protected area, but not necessarily the amount spent in each year, due to possible blocking of budgetary allocations by the federal government, and do not include expenses relating to employees' pay. The annual values since 2008 were also readjusted for annual currency inflation using the IPCA (Consumer Price Index), always considering the reference period (of the previous year). The 2019 LOA values were not readjusted.

To calculate the annual investment per hectare for each protected area category: Integral Protection (IP, IUCN categories I and II) and Sustainable Use (SU, IUCN categories V and VI), we performed a weighted average considering the annual investment values and each category area. The variations in investment were calculated considering the ratio between the available 2019 values compared to 2018, as well as the average for all previous years (2008 to 2018) when necessary.

RESULTS AND DISCUSSION

The total budget originally allocated to the 18 National Protected Areas of the state of Minas Gerais in 2019 was R$3,955,382.76 – 73.63 per cent lower than in 2018 (R$14,997,515.85), the largest budget cut in the history of ICMBio (Figure 2).

Serra do Gandarela National Park © Matteus Ferreira

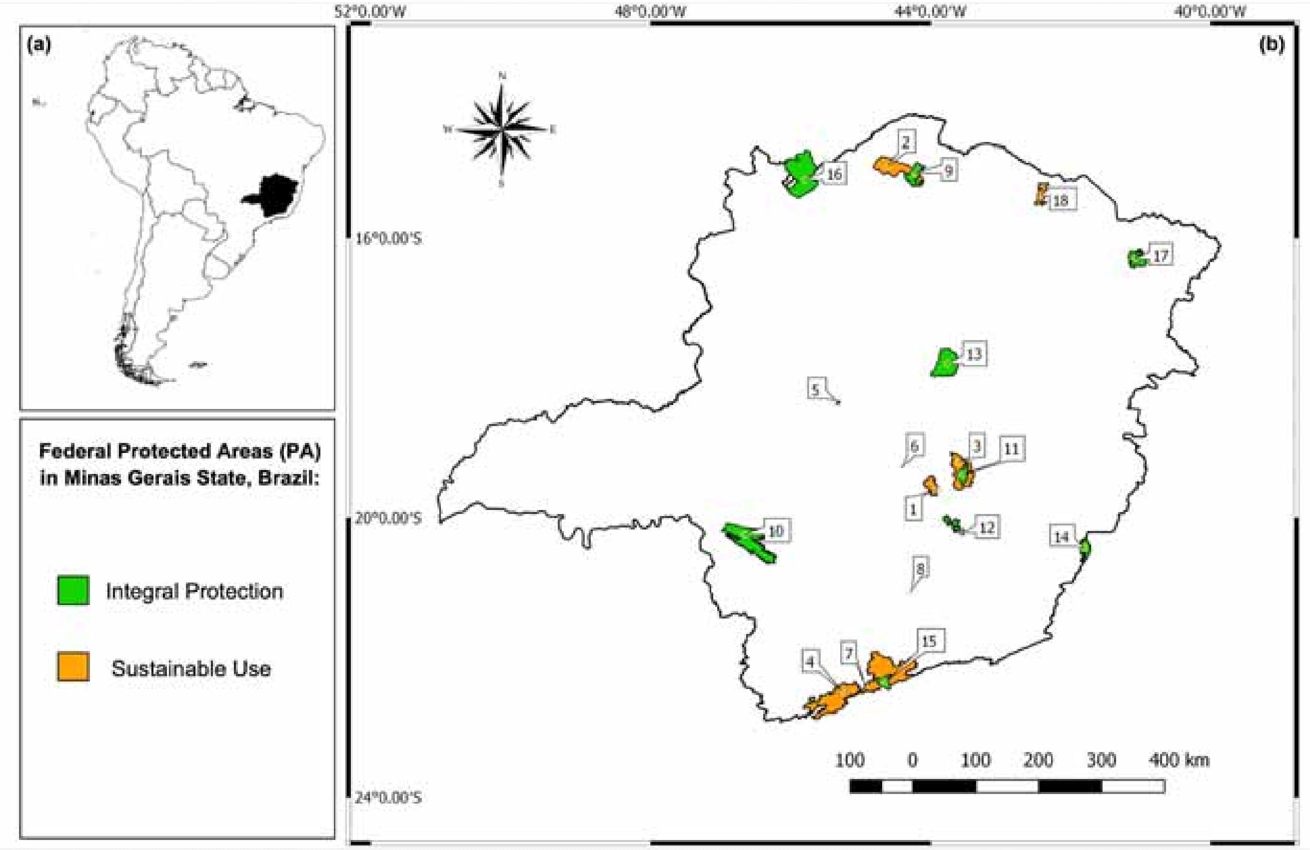

Figure 1. (a) Study area location, the 586.528 km² state of Minas Gerais, Brazil; (b) and the distribution of Federal Protected Areas (PA) of Integral Protection (Green) and Sustainable Use (Orange) in Minas Gerais State, Brazil: 1 – Carste de Lagoa Santa Environmental Protection Area (EPA); 2 – Cavernas do Peruaçu EPA; 3 – Morro da Pedreira EPA; 4 – Serra da Mantiqueira EPA; 5 – Pirapitinga Ecological Station; 6 - Paraopeba National Forest (NF); 7 – Passa Quatro NF; 8 – Ritápolis NF; 9 – Cavernas do Peruaçu National Park (NP); 10 – Serra da Canastra NP; 11 – Serra do Cipó NP; 12 – Serra do Gandarela NP; 13 – Sempre-Vivas NP; 14 – Caparaó NP; 15 – Itatiaia NP; 16 – Grande Sertão Veredas NP; 17 – Mata Escura Biological Reserve; 18 – Sustainable Development Reserve Nascentes Geraizeiras.

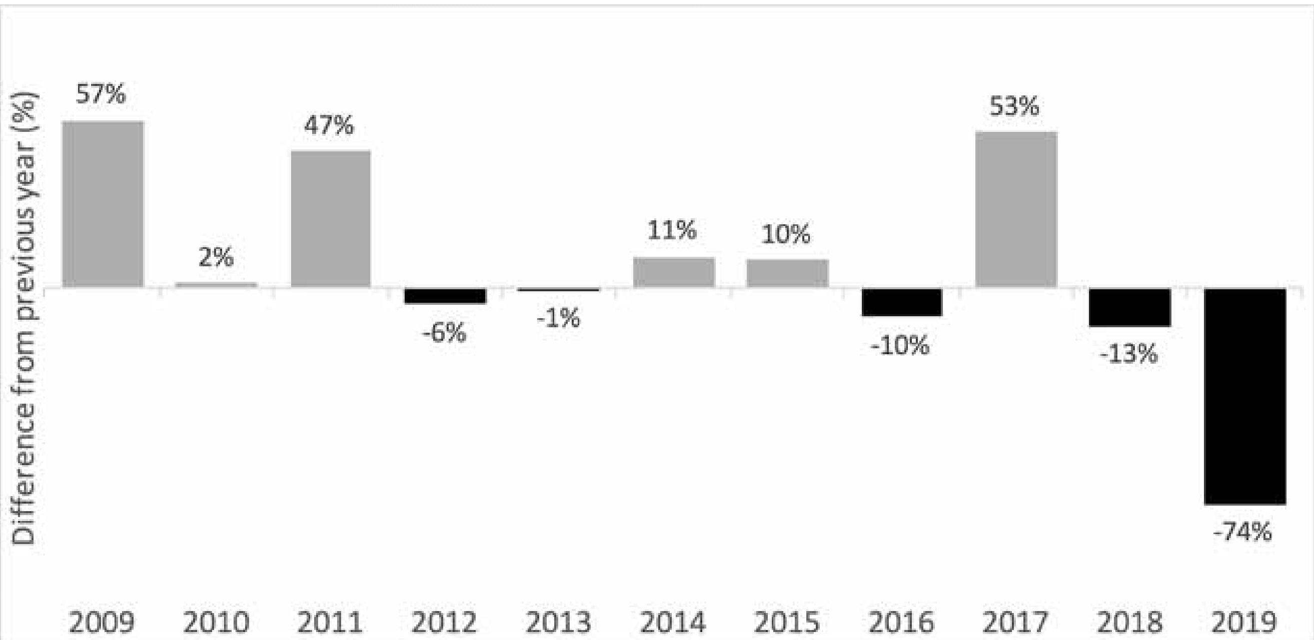

Figure 2. Budget changes (%) in National protected areas of Minas Gerais compared to all previous years of ICMBio (2009–2019). Annual values adjusted by IPCA (Consumer Price Index).

Analysing the budget cut in each category, there was a decrease of 50 per cent in Sustainable Development Reserves (IUCN VI), 64 per cent in National Parks (IUCN II), 86 per cent in Environmental Protection Areas (IUCN V), 93 per cent in Ecological Stations (IUCN 1a), 95 per cent in National Forests (IUCN VI) and 97 per cent in Biological Reserves (IUCN 1a) (Figure 3). As an example, the Environmental Protection Area Morro da Pedreira, which had a budget of R$218,960.58 in 2018, had no money in 2019. Caparaó National Park, despite its proven tourist appeal (62,157 documented visitors in 2017, ICMBio, 2019), also suffered a drastic budget reduction, diminishing from R$1,224,303.50 in 2018 to R$77,814.47 in 2019 (a 93.64 per cent decrease). The detailed values for each of the protected areas can be found in the Supplementary Material.

When we analysed the annual investments per hectare (R$/ha) for Sustainable Use (IUCN IV, V and VI) and Integral Protection (IUCN I and II) categories, the figures were alarming (Figure 4). In 2018, the average annual funding was R$2.94/ha for the SU category and R$16.16/ha for the IP category. Whereas in 2019, only R$0.33/ha and R$4.71/ha were planned, which corresponds to a reduction of 88.77 per cent and 70.85 per cent, respectively. When 2019 values are compared with the annual average from 2008 to 2018, the reduction was 87.29 per cent for SU and 62.09 per cent for IP, demonstrating that this budget decrease is unprecedented in the history of ICMBio.

The historical environmental neglect has worsened in the budget prediction for 2019, generating worrying uncertainties about future government budgets for National Protected Areas in Brazil. Investments are required to solve problems related to land tenure in several protected areas, including the oldest protected area in Brazil. Itatiaia National Park which was created in 1937 but where tenure issues are not yet fully resolved. Another urgent need of the Brazilian protected area system is the elaboration and update of management plans, the most important mechanism established by law to guarantee protected areas' management. Seven of 18 protected areas have management plans that have not been updated for 10 or more years, and five do not even have a management plan (ICMBio, 2019). This goes against the SNUC law (9.985/2000) that requires management plans to be approved within five years after the creation of a protected area (Brasil, 2000). The insufficient budget allocation for these mandatory activities compromises the management effectiveness of these areas (Leverington et al., 2010) and, consequently, their conservation goals. When we compare the federal investments in the protected areas assessed with those of other countries, we see striking differences. United States, South Africa and Argentina invested in 2010, R$ 156.12/ha, R$ 67.09/ha and R$ 21.37/ha, respectively (Medeiros et al., 2011). These amounts are much higher than those invested in the Brazilian protected areas analysed (4.43 R$/ha) for the same period (Medeiros et al., 2011).

In addition, Brazil has demonstrated weaknesses related to environmental issues, as evidenced by ideological statements about the Paris Agreement (Rochedo et al., 2018), controversial projects (Abessa et al., 2019) and the censorship of agency data (Tollefson, 2019). These actions compromise the conservation of biodiversity and

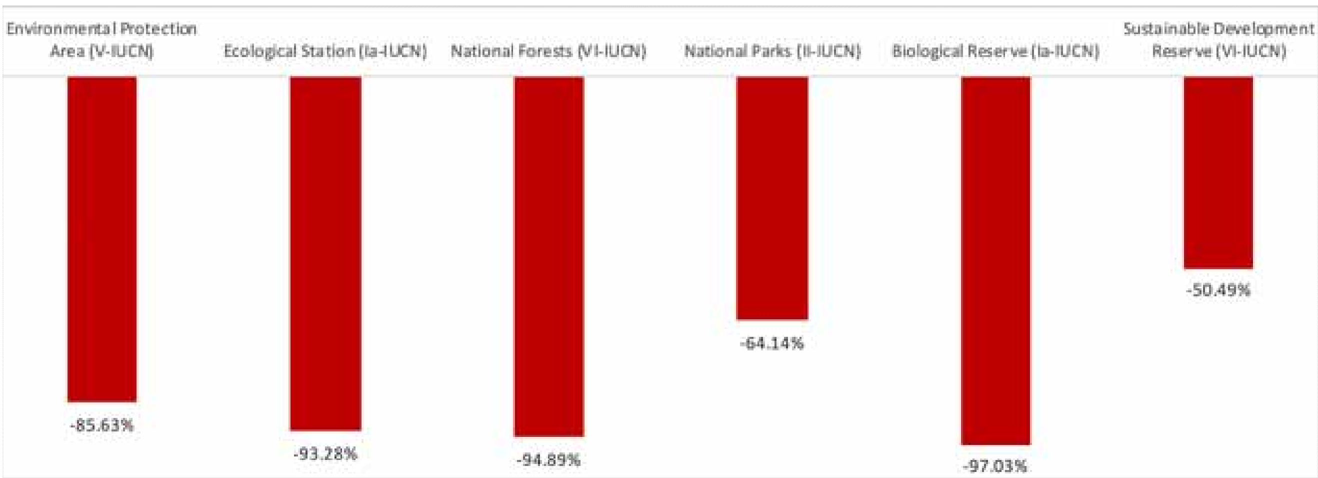

Figure 3. Budget changes (%) in each National protected areas category of Minas Gerais comparing 2019 with 2018. Annual values adjusted by IPCA (Consumer Price Index).

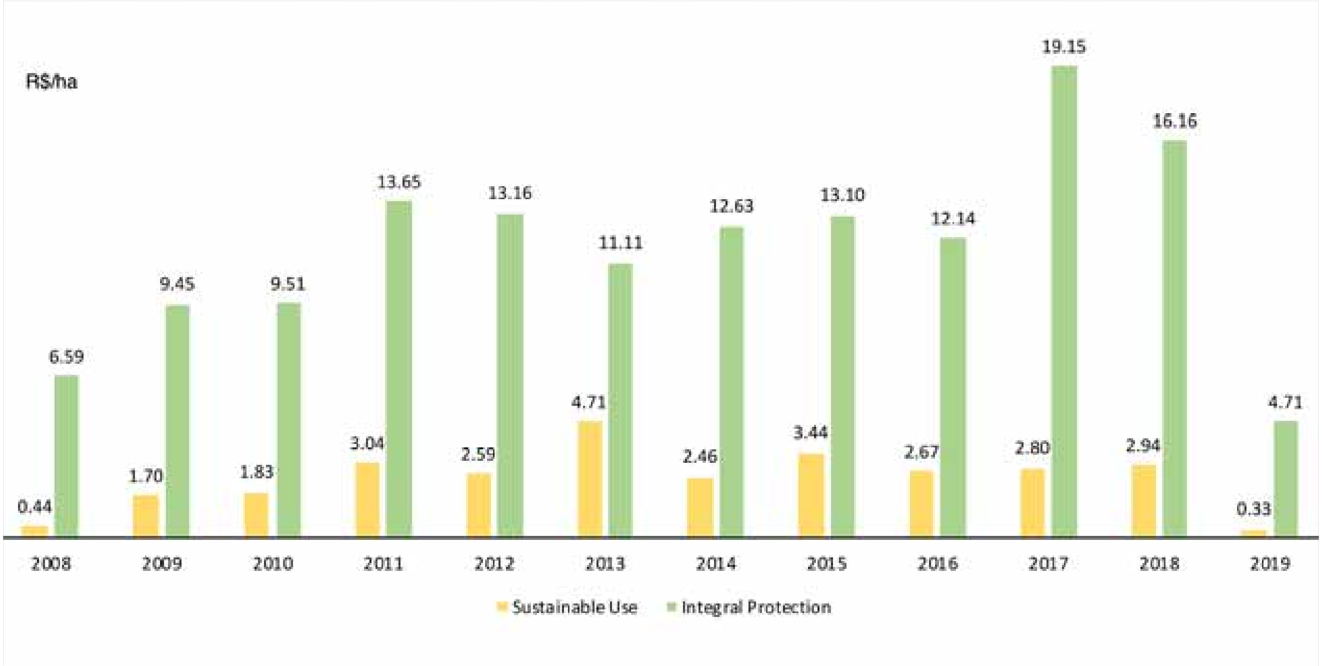

Figure 4. Annual budget per area (R$/hectares), for Federal Protected Areas of Sustainable Use (Orange) and Integral Protection (Green). Annual values adjusted by IPCA (Consumer Price Index)
R$1 = US$0.19 at current exchange rate, 14 September 2020.

the mitigation of climate change effects (Ferrante & Fearnside, 2019). The reduction in international financial resources for the Amazon region (Mendes, 2019) aggravates this scenario since few existing Brazilian federal government resources can be reallocated to overcome this financial deficit, with future impacts on protected areas outside the Amazon region.

Adequate funding, equipment and infrastructure are necessary to increase the management capacity of protected areas, especially in developing countries (Leverington et al., 2010). Different strategies can be adopted to address these issues, such as mandatory environmental offsets by the private sector, and tax benefits. An example is the 'ICMS Ecológico' (Minas Gerais Law 18030/09) (Young, 2005), which is based on a monetary redistribution criterion generated by the Goods Circulation Tax (ICMS) to municipalities. The financial amount that is redistributed to each municipality is determined by a multifactor assessment, including protected area size (hectares), categories, and protected area Quality Factor (QF) (Minas Gerais, 2009). For instance, an improvement of QF by planning, infrastructure, personnel and land tenure can generate more financial resources for the municipalities that host protected areas and encourage projects to promote conservation. As an example, São Roque de Minas (one of the six municipalities that host Serra da Canastra National Park) received R$ 638.303,95 in 2019 from the ICMS Ecológico Law just because of the existence of this protected area (FJP, 2020). However, this value can be more than doubled if the park raises its QF (it was 0.42 – 0.50 in 2019 and is allowed to reach a maximum value of 1.00).

Another possibility for generating more financial resources for national parks is granting concessions for visitor support services to the private sector (ICMBio, 2020). Protected area concessions should be carefully evaluated to avoid waste, habitat destruction and the displacement of local people and wildlife (Wyman et al., 2011). Best practices, like well-defined concession qualifications, and legal and financial responsibilities, are needed to guarantee a financial gain while maintaining the preservation and conservation goals of protected areas (Wyman et al., 2011).

The national system of protected areas in Brazil faces many challenges. Financially, it is necessary to implement a transparency of information system to help public and private sectors, scientists and other stakeholders track and assess the needs of each protected area at different scales (Silva et al., 2019). Also, resource allocation from sectors that generate positive socio-economic results, directly and indirectly, should be a major goal of any government , regardless of their political view. Partnerships between protected areas, the private sector and especially with surrounding communities can guarantee that these precious assets continue to contribute to the conservation of biodiversity and its ecosystem services.

ENDNOTES

[1]R$1 = US$0.19 at current exchange rate, 14 September 2020

SUPPLEMENTARY ONLINE MATERIAL

Annual federal budgets for national protected areas of Minas Gerais State, Brazil

ACKNOWLEDGEMENTS

The authors would like to thank Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for their support. MCF thanks Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for the Master Degree scholarship in Brazil.

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Serra da Canastra National Park © Matteus Ferreira

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RESUMEN

Históricamente, Brasil ha desempeñado un papel destacado como miembro del Convenio sobre la Diversidad Biológica y como signatario del Acuerdo de París sobre el Cambio Climático y varios otros acuerdos internacionales relacionados con el medio ambiente. Con el fin de evaluar la gestión de las inversiones en las áreas protegidas durante los últimos 12 años, analizamos los presupuestos anuales de las áreas protegidas nacionales situadas en Minas Gerais. Este estado comprende tres biomas diferentes, incluyendo dos lugares de situación crítica de la biodiversidad. En todos esos años, las inversiones en unidades de uso sostenible fueron sustancialmente inferiores a las de las áreas de protección integral. En ambos grupos, las inversiones fueron particularmente bajas en 2019, alrededor de un 74% menos que en 2018. Aunque no podemos decir que esta sea una tendencia que continuará en el futuro, la crisis actual en Brasil y en el mundo nos lleva a creer que las áreas protegidas podrían verse comprometidas si no son adecuadamente valoradas como fuentes de salud socioambiental.

RÉSUMÉ

Historiquement, le Brésil a joué un rôle de premier plan en tant que membre de la Convention sur la diversité biologique et signataire de l'Accord de Paris sur les changements climatiques et de plusieurs autres accords internationaux sur l'environnement. Dans le but d'évaluer la gestion des investissements dans les aires protégées au cours des 12 dernières années, nous avons analysé les budgets annuels des aires protégées nationales situées dans le Minas Gerais. Cet état comprend trois biomes différents, dont deux hotspots. Chaque année, les investissements dans les unités d'exploitation durable ont été sensiblement inférieurs à ceux des zones de protection intégrale. Pour les deux groupes, les investissements ont été particulièrement faibles en 2019, environ 74% de moins qu'en 2018. Bien que nous ne pouvons pas affirmer que ce soit une tendance future, la crise actuelle au Brésil et dans le monde nous porte à croire que les aires protégées pourraient être compromises si elles ne sont pas suffisamment reconnues et valorisées en tant que sources de santé socio-environnementale.

HOW TO GET A NATIONAL BIODIVERSITY MONITORING PROGRAMME OFF THE GROUND: LESSONS FROM NEW ZEALAND

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ABSTRACT
The Department of Conservation manages protected areas in New Zealand (32 per cent of the land area) and marine reserves. In recent years, it has come under pressure to provide evidence concerning their biodiversity status and trends. In 2011, the Department implemented systematic monitoring of terrestrial, freshwater and marine systems as part of its Biodiversity Assessment Framework. Data generated now form part of the Department's reporting cycle. The system took six years to become operational and met with strong criticism and calls for its abandonment. Here we discuss the development of the system, the arguments raised against it, and how it was successfully implemented. While technical and logistic elements of a monitoring system are important, ultimately implementation depends more on institutional and social factors. The New Zealand effort would not have proceeded without pressure from governmental oversight agencies for evidence-based reporting, backed by legislation requiring biodiversity information. Internal departmental factors included sustained support for the programme by senior managers in the face of staff disquiet, and continuity of personnel charged with its development. In the long term, survival of the monitoring system will depend on greater uptake and use of the data it provides and protection of its budget from arbitrary reallocation.

Key words: conservation outcomes, ecological integrity, evidence-based policy, evidence-based reporting, long-term biodiversity monitoring, oversight and audit, protected areas

INTRODUCTION
The New Zealand Department of Conservation (DOC) manages and reports on biodiversity on nearly all New Zealand's protected areas (including its National Parks and UNESCO World Heritage sites). The public conservation land and waters that DOC administers make up ca. 32 per cent of New Zealand's land area and include protected marine areas. While DOC has a broader advocacy responsibility for national biodiversity and is the lead agency for administering international biodiversity agreements, biodiversity on privately owned land is the responsibility of landowners, regional councils and the Ministry for the Environment (MfE). DOC has come under increasing pressure over the past 30 years to demonstrate through a more quantitative accounting of its activities how well it is fulfilling its obligations regarding the conservation of biodiversity. The impetus for DOC restructuring and expanding its biodiversity monitoring effort came from several important initiatives and policies (Table 1), and ultimately led to the development of a Biodiversity Assessment Framework (BAF) that became operational in 2011 with implementation of the Biodiversity Monitoring and Reporting System (BMRS).

DOC is responsible to Parliament for the conservation of approximately 8 million ha throughout New Zealand, including offshore islands, virtually all of which has statutory protection of some form, and includes National Parks. It also needs to provide information under the New Zealand Environmental Reporting Act (2015), which is jointly administered by MfE and Statistics NZ, and sets out the requirement for comprehensive monitoring of the nation's atmosphere,

Table 1. Progress in the establishment of a national-scale protected area Biodiversity Assessment Framework (BAF) and Biodiversity Monitoring and Reporting Scheme (BMRS). Progress included events or policies with indirect relationships to the development of both BAF and BMRS, and policy documents often directed progress several years before they were published or enacted.

Year	Milestones
1993	New Zealand becomes a Party to the *International Convention on Biological Diversity* and agrees to report on biodiversity at a national level.
1997	First *State of the Environment Report* (Taylor et al., 1997) highlights shortcomings in environmental and biodiversity data and analysis.
2000	*New Zealand Biodiversity Strategy* (DOC and MfE, 2000) includes priority actions for national monitoring.
2001	Formation of DOC *Key Steps* groups to refocus monitoring on outcomes.
2002	MfE, with DOC as a partner, initiates the national-scale plot forest and shrubland network (Carbon Monitoring System) to quantify carbon stocks and biodiversity.
2004	DOC development team reviews New Zealand monitoring and national monitoring systems; recommends ecological integrity as overall goal and outlines a Biodiversity Assessment Framework (BAF) (Lee et al., 2005).
2005	The Land-Use and Carbon Analysis System (LUCAS) established by MfE with DOC as partner, provides a basis for national level biodiversity monitoring.
2005	Green & Clarkson (2005) review *New Zealand Biodiversity Strategy* progress, highlight lack of a framework and a condition and trend-monitoring network.
2006	DOC business case signed off for BAF and development continues on the BMRS.
2010	DOC BMRS programme approved.
2011/12	DOC BMRS monitoring begins with national-scale sampling (Tier 1 monitoring in Figure 1).
2012	DOC annual report includes monitoring data from the BMRS programme.
2015	New Zealand Environmental Reporting Act (2015) passed. Includes ecological integrity as a national goal and establishes legislative requirement for monitoring.

air quality, land, freshwater and marine systems. DOC is also subject to several oversight agencies that monitor and assess its performance. The Treasury signs off departmental budgets and has been increasingly active in demanding evidence-based justification for expenditure. The State Services Commission oversees the performance of government agencies and its governmental Performance Improvement Framework is explicit as to the information required for assessment of progress, and the Office of the Auditor-General undertakes regular audits and reviews of how well this obligation is being fulfilled. Statistics NZ provides guidelines and advice on the collection and analysis of data and is responsible for the archiving and custody of New Zealand-level statistics. The Commissioner for the Environment reports and makes recommendations to Parliament including on biodiversity matters affecting DOC.

Neither the Biodiversity Strategy (DOC & MfE, 2000) nor the subsequent Environmental Reporting Act (2015) has detailed how biodiversity monitoring is to be carried out, or given anything but general guidance as to what is to be included. While DOC is able to actively manage only a small proportion (about one-eighth) of New Zealand's conservation land and about 200 of the 2,800 threatened species, it needs to have broad-scale information to justify its priorities in this regard (Office of the Auditor-General, 2012). Moreover, establishing these priorities does not release it from its obligation to understand what is happening in protected areas that it is not actively managing. The DOC development team therefore concluded that national-level, comprehensive biodiversity monitoring was necessary to understand the multiple threats to ecological integrity in protected areas.

National-level systems such as the BAF and BMRS are uncommon, and most national biodiversity reporting has been based on often unsatisfactory data collected by uncoordinated local systems (Reyers et al., 2013). Here we outline the genesis, development and implementation of the BAF/BMRS with a focus on the problems faced and overcome. Our hope is, that with a better understanding of the forces both acting for and against such systems, more organisations will rationalise and organise protected area monitoring at national, state or provincial scales.

STRUCTURE OF THE BIODIVERSITY ASSESSMENT FRAMEWORK

McGlone et al. (2020) discuss the BAF, its structure and high-level goals (Figure 1), and broad objectives (Table 2) and how they relate to ecological integrity and ecosystem health. Research that underpins the BMRS has been well documented (MacLeod et al., 2012; Allen et al., 2013; Gormley et al., 2015). The BAF framework is hierarchical (Figure 1), with maintenance of ecological integrity as an overarching goal, further decomposed into eight broad outcome objectives (Table 2). The outcome objectives are supported by indicators that state what aspects should be included, and these are supported by measures in which the concrete components are detailed. Finally, elements, the data which will be collected and analysed, are listed. The BMRS then decides which elements from BAF will be prioritised based on criteria including importance, urgency, pre-existing data sets, logistics and finance and then develops protocols and organises monitoring. Much data is provided by partnership with the long-established LUCAS network (Allen et al., 2003). With strict monitoring protocols around collection, archiving and analysis ensuring compatibility between data sets collected at different times and places by different teams, monitoring networks provide high quality data and are remarkably robust (Coomes et al., 2002).

The BMRS programmes fall into three groups: Tier 1, systematic, long-term monitoring for national context; Tier 2, nationally consistent monitoring of those

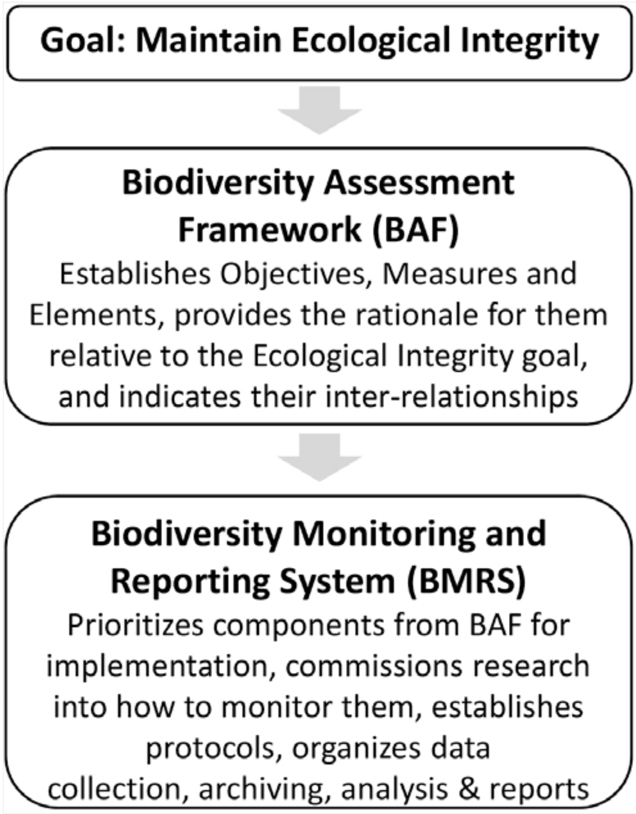

Figure 1. Interrelationships between New Zealand's Biodiversity Assessment Framework (BAF) and the Biodiversity Monitoring and Reporting System (BMRS) to support the overall goal of maintaining ecological integrity.

Table 2. The eight outcome objectives of the Biodiversity Assessment Framework (BAF)

Objective	Coverage
Maintaining ecosystem processes	The extent to which the environment is capable of supporting indigenous ecosystems and the degree to which they are free of disturbance factors that lead to poor ecological outcomes.
Limiting environmental contaminants	Presence and concentration in the environment of non-nutrient contaminants including faecal bacteria, vertebrate toxins, pesticide residues and heavy metals, hormones or hormone mimics as a result of human activities. Persistent litter and disruptive noise in the aquatic environment.
Reducing spread and dominance of exotic species	Documentation of the presence, dominance and rate of increase of exotic species in the natural environment.
Preventing declines and extinctions	Conservation status of all species in the New Zealand biota (as per the New Zealand Threat Classification System); security of threatened and at-risk taxa; loss of genetic diversity in critically reduced taxa.
Maintaining ecosystem composition	Demography of functional groups, their representation, abundance of common and widespread taxa and changes in species diversity.
Ensuring ecosystem representation	The extent, protection status and ecological condition of indigenous ecosystems.
Adapting to climate change	Documentation of changing climates, and the biological responses.
Fostering human use and interaction with natural heritage	Documentation of how humans interact with natural ecosystems in their harvesting of both indigenous and exotic taxa, through recreation within them, and how they use them to gain spiritual and physical wellbeing.

protected areas and species being actively managed for reporting on trends and management effectiveness; Tier 3, intensive, targeted monitoring for research and evaluation (Figure 2). While Tier 2 and Tier 3 monitoring have a local focus, application of consistent protocols, data analysis and archiving facilitate a roll-up to higher or national levels. The BAF is modular and new components can be introduced or redundant ones removed with little disruption. It is comprehensive and, in outlining what an ideal system would be, ensures that decisions on what to include in the BMRS are made with a good understanding of the potential choices. Finally, while threats to biodiversity play a large role in the structuring of the BAF, it also asks for the collection of contextual data. Further details are given in McGlone et al. (2020) and results from currently active components of the BMRS are detailed on the DOC website (https://www.doc.govt.nz/our-work/monitoring-reporting/national-status-and-trend-reports-2018-2019).

DEVELOPMENTAL AND IMPLEMENTION ISSUES

Development and implementation of the BAF/BMRS were complex and difficult. Every substantive organisational or social problem we encountered was outlined in a publication on the development of the Western Australian Rangeland Management System (Watson & Novelly, 2004). Following their lead, we discuss the various environments that determine the success or failure of a monitoring system.

The scientific environment

Many scientists are sceptical of long-term monitoring programmes of the status and trend type central to the BMRS. It is frequently suggested that they are: not based on a particular management problem or scientific question; not optimised; poorly specified or lacking *a priori* hypotheses; too broad in scope; poorly stratified or not replicated, and biased; often of low statistical power; and often consist of large but inefficient sample

Figure 2. The New Zealand Biodiversity Monitoring and Reporting System's (BMRS) hierarchical structure from national (broad-scale) monitoring through to site-specific, research studies.

sizes (Nichols & Williams, 2006; Wintle et al., 2010). These critics argue that poorly thought-out and implemented monitoring wastes resources, and of course this is true. In its place they suggest monitoring based on scientific hypotheses and targeted towards assessing conservation actions (Nichols & Williams, 2006). In particular, they prefer 'question-driven' monitoring that makes *a priori* predictions which are then tested, ideally by adaptive management (Lindenmayer & Likens, 2010). However, although approaches combining observations, experiments and theory are superior for advancing ecological understanding (Wotton & Pfister, 1998), they are resource-intensive and thus will limit the system's scope and focus to known threats more than is perhaps wise. Adaptive management experiments in particular, despite their great potential, are prone to disappointing outcomes (Allen et al., 2011), and are often abandoned before rigorous results are obtained (Westgate et al., 2013).

The conservation environment

From our New Zealand experience, many conservationists are indifferent to or sceptical of the value of data. Monitoring is often believed to be a waste of scarce conservation resources, as the problems and their solutions are thought to be well known. Therefore, many conservation organisations cannot credibly assess their effectiveness and impact (O'Neill, 2007; Josefsson et al., 2020). For instance, in New Zealand, community restoration projects are popular but little monitoring is done, and the few groups that do monitor are unconvinced of the benefits of sharing their data (Sullivan & Molles, 2016).

The institutional environment

Watson and Novelly (2004) set out the institutional problems faced by a monitoring system. As noted by a respondent to an Australian study of environmental monitoring and evaluation practices, when the need for these activities is raised, leaders "nod their heads and go 'Mmm' and nothing happens" (McIntosh, 2019). Even when undertaken, monitoring is often diffuse, spread over multiple budgets, and vulnerable to neglect or relegation. The focus is on easily obtained data related to implementation measures. As Kapos et al. (2009) have shown, this is largely irrelevant as regards outcomes. When outcome measures are reported, the focus is on places and species where most effort is directed and success more likely. For an organisation such as DOC, with an overall responsibility for protecting natural ecosystems but lacking commensurate funding, biodiversity status and trend reporting will inevitably give the impression to some extent of continuing failure. It is difficult for any organisation to present data placing it in a poor light and most avoid doing so (Pentland, 2000). A culture of critical evaluation of outcomes is therefore often lacking (Kapos et al., 2009).

BMRS Tier 1 Field teams completing the monitoring and measurements of biodiversity on a forested plot © Mike Perry, Department of Conservation

An ever-present risk is organisational restructuring and turnover. The massive realignment of New Zealand public institutions in the 1980s and 1990s destroyed much biodiversity capacity through loss of funding, staff, institutional knowledge and data (Young, 2004). DOC has had three restructurings since 2004, and the BAF/BMRS survived only because key staff remained in place despite restructuring, an indication of the importance that the programme had acquired.

The individual environment

Within a conservation organisation, be it governmental or not, the focus is on direct action to make a difference. Therefore, monitoring is often lacking or short-term, driven by individual enthusiasm and often involves idiosyncratic techniques and a lack of secure data archiving or analysis. When the place, target, methods and timing are at an individual's discretion, monitoring can be highly enjoyable, yields information of direct relevance to local issues, provides job satisfaction, and career enhancement through development of individually held expertise. Such activities are therefore supported by conservation staff. However, few such individually initiated monitoring efforts transition to the second or third generation (Westoby, 1991). Because these efforts absorb resources but often yield little permanent benefit, they need to be replaced or at least augmented by standardised sampling regimes supported by protocols, data analysis and archiving. However, our experience is that monitoring protocols are adhered to only when rigorously backed up with regular training and review because participants are reluctant to abandon favoured techniques, cut corners for cost or time reasons, and often experiment with new techniques or simply drift from the guidelines. A further factor is that systematic monitoring may be viewed as uninteresting or irrelevant as it often involves control sites where no management activity has taken place, or common species in unremarkable locations. If monitoring programmes are perceived as not delivering immediate benefits to staff, overt or surreptitious attempts to thwart them will inevitably begin.

Managers, as recognised by Watson and Novelly (2004), want to leave a mark on their organisation. They are therefore loath to commit too much time or energy to promotion and management of pre-existing, long-term programmes that lock up funding that could otherwise be deployed on new initiatives.

All these problems were manifest within DOC. A *Performance Improvement Review* by the State Services Commission (2014) stated that, although many within the organisation were strongly values-based and passionate about conservation, there was "...limited enthusiasm for evaluation as a regular part of DOC business activity". Conservation still mainly relies on expert opinion, anecdote and intuition: an evidence-based culture is not widespread in New Zealand or elsewhere (Cook et al., 2012; Sutherland et al., 2004).

Funding environment

Science funding agencies in New Zealand and elsewhere are reluctant to fund long-duration programmes. Well-established long-term monitoring networks such as NEON in the United States and TERN in Australia undergo periodic crises in funding (Mervis, 2015; Lindenmayer, 2017). Donors to NGOs often specify that their contributions are spent only on conservation action. Despite the New Zealand Environmental Reporting Act (2015) mandating comprehensive reporting, no provision under the Act is made for funding the collection of data.

HOW THE BIODIVERSITY ASSESSMENT FRAMEWORK HAS ADDRESSED THESE ISSUES

Initial steps

In 2004, a development team of managers, conservation professionals, conservation scientists, ecologists and ecological modelers drawn from the government-owned Crown Research Institute Landcare Research and DOC began development of a new comprehensive monitoring system. The team early on became mired in heated discussions about approaches and techniques. The issue of whether monitoring should be focused on assessing the success or otherwise of conservation interventions (Overton et al., 2015), or have a broader ambit including surveillance, common organisms and regions not under management, split the team. In retrospect, the group should have been less technically focused and more inclusive, as many of the debates were about broad goals

Helicopter landing in alpine to pick up BMRS Tier 1 field teams © Kathrin Affeld, Department of Conservation and issues (What is the ultimate aim? Which components of biodiversity? Who will do the monitoring? At what cost?) that cannot be settled by science alone. Participation of NGO, local body and central government participants (such as MfE, Treasury, Statistics New Zealand) would have been advantageous to complement a group largely made up of scientists.

As part of the initial investigation, a comprehensive review was carried out of national and DOC monitoring, together with a review of Australian, British, Canadian, European Union and United States monitoring systems (Lee et al., 2005). Preparation of this review helped the development group to reach two major conclusions: first, that the overall goal of conservation in New Zealand should be ecological integrity; second, that monitoring would be broadly inclusive and national (McGlone et al., 2020). Given there are large information gaps regarding New Zealand biodiversity, it was realised that monitoring that was narrow in scope ran the risk of giving an incomplete picture. Furthermore, a focus on conservation interventions would neglect most conservation land and deprive managers of vital comparative background data. The Local Unit Criteria and Indicators Development (LUCID) forest monitoring programme of the US Department of Agriculture (Wright et al., 2002) was selected as a suitable template for further development.

Consultation

The broad outline of the BAF and the proposal for monitoring under the BMRS were presented at a series of workshops for DOC staff around the country and to the ecological community at a monitoring symposium in 2004. The development team published its review of needs, international monitoring programmes and an outline of goals and potential indicators and measures in 2005 (Lee et al., 2005). During the development of the individual monitoring components of the BMRS, workshops for DOC staff were held and reports and peer -reviewed publications produced detailing the finalised proposals.

While the ecological community was therefore well aware of the plans for a new monitoring system, the development group did not anticipate just how severe the criticism of the proposal was to become. These later critiques (McSweeney, 2013; Brown et al., 2015) focused on the wisdom of broad-scale monitoring. As discussed below, Tier 1 monitoring is not the only component of the system, but this is widely misunderstood. It may have been helpful to have engaged directly with some of these influential critics earlier in the process to ensure that at the very least they grasped the intent of the whole BAF/BMRS scheme.

Research, protocol development and review

Intensive development of methodology and small-scale trials were initiated which took several years. Research was commissioned on all aspects, including sampling design, and power analysis (MacLeod et al., 2012; Allen et al., 2013; Gormley et al., 2015). Protocols for monitoring were developed and updated, manuals written and training sessions for staff undertaken. Scientists with experience in international monitoring programmes undertook external reviews and discussed the project. The programme was commended by the Auditor-General's Office in their regular review of DOC performance.

The project was also subject to internal assessment and critique. An internal DOC managerial review focused on the 2010 business plan which directed resources diverted from local monitoring projects to Tier 1 (national scale) monitoring (Figure 3). Objections put forward by affected managers covered a wide range of

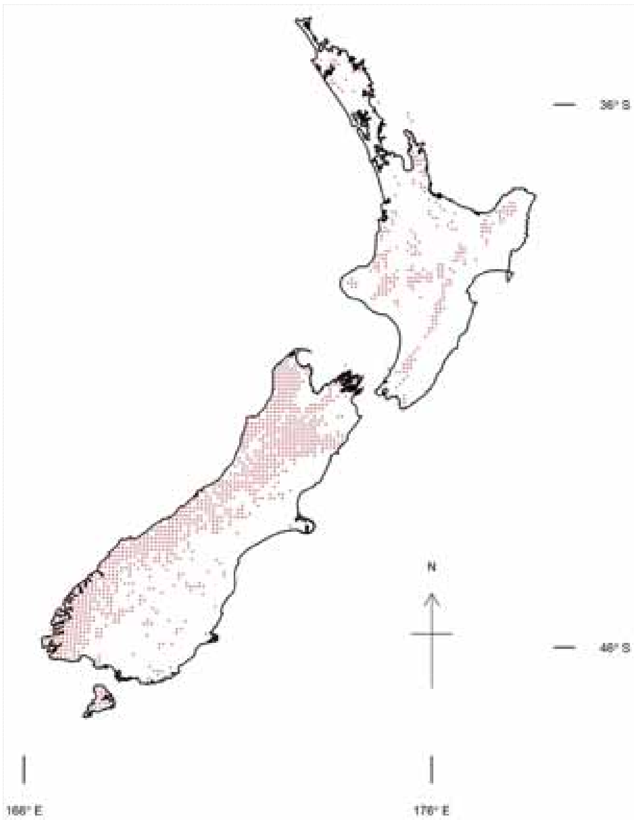

Figure 3. Distribution of sampling points for Tier 1 (broad-scale) monitoring on public land throughout New Zealand in the Biodiversity Monitoring and Reporting System (BMRS).

issues. The lack of relevance of Tier 1 monitoring to DOC's main responsibilities because rare and endangered species and ecosystems would be under-represented was raised. This objection was largely due to a misunderstanding of the implementation plan, in which Tier 1 was essentially underway, while Tier 2 was in development. However, it also reflected a misunderstanding of DOC's role. While it needs to prioritise its actions, it has a duty to report on the consequences of such priorities for areas where it undertakes no management. Objection was made to the burden of national-level monitoring falling to DOC and the expense of Tier 1 monitoring. However, DOC has oversight of all biodiversity on conservation land, and thus has national-level responsibilities it cannot avoid. We agree that systematic monitoring schemes are expensive but their inherent flexibility means that costs can be deferred if need be without doing major damage. Some managers questioned the wisdom of centralisation because local knowledge and skills would be lost. We agree this is a short-term concern, but much of this local knowledge is ephemeral as it is rarely well documented or archived and turnover of staff inevitably means loss of this knowledge. Managers also argued that existing monitoring expenditure had been overestimated and was therefore not available for diversion. This argument is just one of the many familiar institutional ploys to resist resource reallocation. Finally, some managers argued that as Tier 1 monitoring was long-term and broad-scale, the most likely outcome that would be observed would be no significant change, and this could put DOC at risk of negative reviews. This was the most concerning of all, as it speaks to a situation in which the main aim of managers is to portray their activities as having been successful and their wish to have monitoring to reflect this through focusing almost entirely on areas of intense management effort, and to ignore the broader situation where the state of New Zealand's national biodiversity continues to decline (Green & Clarkson, 2005; Brown et al., 2015).

Organisational change

It is often stated that a monitoring system needs a champion or a small group of enthusiastic, dedicated individuals (Lindenmayer et al., 2014) and indeed this seems to be the case in practice (McIntosh, 2019). As comprehensive monitoring systems will invariably face stubborn opposition, we agree that champions are needed initially. However, if a monitoring system is to survive, reliance on individual initiative must be superseded by an organisational solution. National-level, long-term monitoring requires centralised coordination, logistical expertise, trained monitoring staff, and a secure budget.

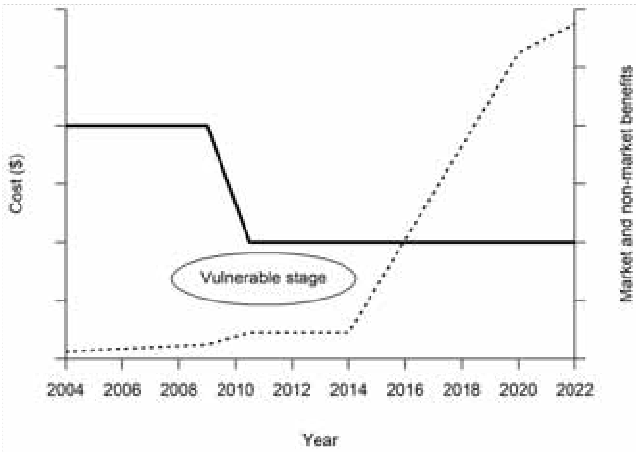

Figure 4. Developing and deploying a monitoring scheme is expensive and the benefits are slow to be realised. Schemes have a vulnerable stage during the mid- to late-deployment and early-delivery phases, when resource requirements are high (solid line) and outweigh benefits (dashed line). After Watson & Novelly (2004), with permission from John Wiley & Sons, Inc.

Dealing with opposition

Watson and Novelly (2004) give an example of the predictable sequence of events that opposition to monitoring programmes follows (Figure 4). Opposition is muted at first because ambitious programmes generally collapse under their own weight and thus inaction or passive resistance is the wisest course. Opposition increases after several years of programme operation when the disruption, development and start-up costs are apparent, but not the benefits. This vulnerable stage lasts from year 4 to year 8, by which time sufficient monitoring cycles have been completed to demonstrate its value.

The BAF/BMRS followed this pattern: in 2006 approval was given for development and Tier 1 monitoring was initiated in 2011. A severe, highly public critique of the system followed in 2013 (McSweeney, 2013). Further criticism that the benefits did not match the costs came with the publication of *Vanishing nature: facing New Zealand's biodiversity crisis* (Brown et al., 2015). The timing closely fitted the Watson–Novelly model (Figure 4). Within DOC, commencement of centralised, protocol -based monitoring and decreased local autonomy became a focus of resentment. This development could have been anticipated given that external reviews of DOC revealed a significant disconnect between many of its professional staff and management (Office of the Auditor-General, 2012). Opposition came from managers whose operations and staff would be affected by the BMRS. Vital support at this stage came from upper-level managers who were championing the programme, and the governmental oversight agencies (State Services Commission, Office of the Auditor-General) who had been promoting better and more systematic assessment programmes in the government sector. Providing well documented plans, analyses, research and preliminary results to bolster this support was essential.

In retrospect, although establishing Tier 1 monitoring as the first operational component of the BMRS made logistical sense as it built on a pre-existing programme (LUCAS), it made the promotion of the broader concept difficult. Critics saw Tier 1 as the whole programme and assumed that rare and endangered species and habitats would be ignored. Faster delivery of relevant, local monitoring information would have made the whole project more palatable.

CONCLUSIONS

"*Good systems tend to violate normal human tendencies*" William Eckhardt (quoted in: Poundstone, 2019).

Monitoring and reporting of status, trend and outcomes is well established for many aspects of our society. We expect up-to-date information on a nation's population, finances, safety and health and a myriad of other aspects of modern life. We do not expect policy and assessment to be based solely on the 'local knowledge' of practitioners – no matter how valuable this is. Biodiversity monitoring and reporting is well out of step with these international trends. National-scale biodiversity monitoring systems have been slow to develop because, while many organisations and researchers could make use of the data, its collection is not a high priority for them. Those systems which have developed often arise from forest monitoring networks which, at least initially, had a clear commercial imperative (see for example, the Mexican national biodiversity system: Garcia-Alaniz et al., 2017). Given the scientific, institutional and individual resistance to large-scale, systematic monitoring, only a well-organised, well-supported national approach can succeed.

The key to developing a national system is therefore two-fold. First, high-level governmental pressure has to be exerted to make monitoring a priority. Second, monitoring has to be placed in the hands of those who see monitoring itself as a mission and who derive professional and individual satisfaction from doing it well. While citizen science initiatives such as iNaturalist can provide useful support, they cannot substitute for this core professional expertise (McKinley et al., 2017).

On the basis of our experience, if the following factors are lacking, we would not advise initiating a systematic monitoring scheme at a national scale:

- legislation mandating the collection of biodiversity information;
- governmental oversight and audit agencies exerting pressure for evidence-based reporting;
- biodiversity agencies engaged in evidence-based policy and assessment;
- inter-institutional support for collective effort.

The most important practical considerations for systematic monitoring at any scale are:

- a high-level framework to guide and coordinate lower-level effort;
- research guiding statistically valid selection of sites, ecosystems and organisms;
- development of monitoring expertise, training and development of strictly implemented protocols;
- a dedicated budget not subject to large yearly fluctuations.

To ensure longevity, we believe the following might be important:

- professional biodiversity monitoring staff;
- regular presentation of results and findings through annual reports, policy and business papers and the media that demonstrate the value of monitoring;
- freely available monitoring data to support research, conservation activity, and feedback through scientific publications and peer review.

We have described how New Zealand got a national biodiversity programme off the ground but are well aware of issues around its continued ability to fly. Even though the BMRS provides the evidence base needed for conservation and policy purposes, its future is by no means secure. As a long-term organisational commitment, it remains vulnerable to budget cuts if other aspects of the DOC's operations are considered to have higher priority. In this, it is no different from many other activities. However, the great advantage of setting up systematic, professionally conducted monitoring is that it provides data and infrastructure of permanent worth. In this sense, it is crash-proof. Establishment of networks of monitoring sites and locations, documented procedures that are well adhered to in practice, and archiving and publication of results (Bellingham et al., 2020) ensure that hiatuses in data collection are less damaging than they otherwise might be. However, the best guarantee of continuity must be the eventual acceptance by national governments that, if they accept that they have a duty to protect biodiversity, they must also accept responsibility for the systematic collection of information about it, just as they do for so many other aspects of modern life.

ACKNOWLEDGEMENTS

Kevin O'Conner, Steve Donkin, Allan Ross, Mike Slater, John Cumberpatch, and Mike Perry all provided critical support, at various stages, in getting the Biodiversity Assessment Framework off the ground. Rob Allen and Kevin Collins provided comments on the manuscript. The New Zealand Department of Conservation funded preparation of this manuscript. Bellingham, Richardson and McGlone acknowledge additional support of Strategic Science Investment Funding (SSIF) for Crown Research Institutes from the New Zealand Ministry of Business, Innovation and Employment's Science and Innovation Group.

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RESUMEN

El Departamento de Conservación gestiona las áreas protegidas de Nueva Zelanda (32% de la superficie terrestre) y las reservas marinas. En los últimos años, se ha ejercido presión para que aporte pruebas tanto en relación con su situación como con las tendencias en materia de biodiversidad. En 2011, el Departamento puso en práctica la vigilancia sistemática de los sistemas terrestres, de agua dulce y marinos como parte de su Marco de evaluación de la biodiversidad. Los datos generados forman ahora parte del ciclo de presentación de informes del Departamento. El sistema tardó seis años en entrar en funcionamiento y fue objeto de fuertes críticas y exigencias para que se abandonara. Aquí analizamos el desarrollo del sistema, los argumentos que se presentaron en su contra y cómo se logró implementar con éxito. Si bien los elementos técnicos y logísticos de un sistema de vigilancia son importantes, la implementación depende –en última instancia– más de factores institucionales y sociales. El esfuerzo de Nueva Zelanda no habría avanzado sin la presión de organismos gubernamentales de supervisión para la presentación de informes sobre la base de datos comprobados, respaldados por legislación que requiere información sobre biodiversidad. Entre los factores departamentales internos cabe citar el apoyo sostenido al programa por parte de los altos directivos ante las preocupaciones del personal, y la continuidad del personal encargado de su desarrollo. A largo plazo, la supervivencia del sistema de vigilancia dependerá de una mayor asimilación y utilización de los datos que proporciona y de la protección de su presupuesto frente a una reasignación arbitraria.

RÉSUMÉ

Le Département de la Conservation gère les aires protégées en Nouvelle-Zélande (32% de la superficie terrestre) et les réserves marines. Ces dernières années, il a fait l'objet de pressions visant à fournir des preuves concernant l'état des aires protégées et de leurs orientations en matière de biodiversité. En 2011, le Ministère a mis en œuvre une surveillance systématique des systèmes terrestres, d'eau douce et marins dans le cadre de son évaluation de la biodiversité. Les données générées font désormais partie du cycle de présentation des rapports du Département. Le système a mis six ans pour devenir opérationnel et a rencontré de vives critiques et des appels à son abandon. Nous abordons ici le développement du système, les arguments avancés à son encontre, puis la manière dont il a été mis en œuvre avec succès. Bien que les éléments techniques et logistiques d'un système de surveillance soient importants, sa mise en œuvre dépend davantage, en fin de compte, de facteurs institutionnels et sociaux. L'effort de la Nouvelle-Zélande n'aurait pas été réalisé sans la pression des agences de surveillance gouvernementales pour obtenir des rapports fondés sur des données probantes, appuyés par une législation exigeant des informations sur la biodiversité. Les facteurs internes au service comprenaient l'appui soutenu des cadres pour le programme face à l'inquiétude du personnel, et la stabilité du personnel chargé de son développement. A long terme, la survie du système de surveillance dépendra de son utilisation accrue, de l'application des données recueillies et de la protection de son budget contre une réaffectation arbitraire.

THE VULNERABILITY OF NEIGHBOURING COMMUNITIES AND THEIR INVESTMENT IN PROTECTED AREAS: A SPECULATIVE ANALYSIS

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ABSTRACT
Climate change will increasingly impact species and habitat composition of protected areas, even if precise impacts are difficult to predict, especially in smaller areas. This raises questions for management authorities, not only regarding the ecological integrity of protected areas but also regarding wildlife that 'escape' and cause damage.
The protected area is traditionally the primary responsibility of the management authority, but the introduction of charismatic and potentially damage-causing wildlife touches on the overlapping and shared commercial interests of the tourism industry and the neighbouring rural communities. As climate change manifests, the complex relationship between these three stakeholders is likely to become strained by the increased frequency of damage caused by wildlife as they attempt to move out of or expand their home ranges beyond the boundaries of the protected area. It is concluded that a laissez-faire approach to climate change by conservation authorities or protected area managers is likely to be problematic – particularly with respect to relationships with neighbouring rural communities. A greater awareness of climate change impacts among all stakeholders is required, including conservation agencies, the tourism industry and neighbouring rural communities and managing escaped wildlife should become a joint responsibility which is founded on a contractual agreement between these stakeholders.

Key words: Climate change, compensation, conservation, Covid-19, human–wildlife conflict, protected areas, rural communities, surrogate information, Wild Dog

INTRODUCTION

Since the democratisation of South Africa in 1994 and the restitution of land to communities that were dispossessed of land during the apartheid era, there has been an increase in the number of community-owned protected areas as well as community-owned (in full or part) nature-based tourism or game lodge facilities within established protected areas (Koelble, 2011). This commercial interest of local communities has empowered them to have a substantial interest in the proper performance of tourism in the protected areas. Such shared commercial interests appear to be no different to those experienced elsewhere in Africa and beyond, where local communities have become owners of protected areas in addition to enjoying a direct commercial role in nature-based tourism (Shafer, 2020). This trend in biodiversity conservation brings additional economic vulnerability to these communities in the face of climate change, the significance of which is yet to be investigated.

At a protected area level, climate change research has mainly focused on the displacement of habitats and species and the increase in human–wildlife conflict that results from an increased migration of wildlife out of protected areas into neighbouring areas, due to reduction or loss of habitat or prey (Lamichhane et al., 2018). The scope of this research epitomises the challenges protected areas and protected area management face, as the consequences of climate change continue to manifest themselves. These challenges give rise to the primary concern that the ecological values and biodiversity within existing protected areas (and hence their management) are likely to deviate from the values for which the area was originally established (Goosen & Blackmore, 2019), and that new protected areas will be required to maintain the current protection of representative samples of a country's biodiversity.

While the direct and indirect impacts of climate change are difficult to predict and monitor, let alone the determination of causation at sub-landscape levels, the impacts of climate change on wildlife are likely to be more prevalent in smaller protected areas than larger ones (Carter et al., 2014). This assumption follows from the reasoning that the spatial extent of larger protected areas is likely to provide greater opportunities for stressed wildlife to relocate to more suitable habitat, without necessarily challenging retaining fences or moving across the boundary of the protected area (Di Minin et al., 2013). The smaller a protected area, the fewer the opportunities for wildlife to meet their needs within the area when conditions change.

Other than catastrophic events characteristically associated with climate change, the more subtle impacts of climate change on a protected area may not be easily discernible, in the short to medium term, from natural habitat dynamics caused by a combination of the general stochastic behaviour of wildlife and seasonal climate variation, protected area management, and human-induced disturbance (e.g. tourism, poaching). As a result, there is unlikely to be a discernible temporal threshold between incidental breakouts of wildlife from the protected area and that primarily caused by a changing climate. It is logical, in the absence of clear evidence and assuming that climate change may cause or intensify breakouts, for protected area management authorities to undertake a cautious and risk-averse approach to wildlife management and to build into their protected area management strategies mechanisms to ameliorate the growing impacts of climate change (Rannow et al., 2014). Such strategies may encompass, changes in vegetation management (i.e. altering burning regimes), and reducing the numbers of breakout-prone animals, or relocating (some of) them to other suitable existing or newly established protected areas (Wilke & Rannow, 2014).

Each of these management options in light of a changing or already altered climate have direct and indirect consequences for both the conservation of biodiversity as well as the socio-economic well-being of the protected area (Fisichelli et al., 2015). In the absence of sufficient government subsidies, the latter is predominantly dependent on the tourism appeal and concomitant revenue-generating potential of the protected area (Saayman & Saayman, 2017). From a wildlife perspective, the tourism appeal of an area is not limited solely to large charismatic species such as, or equivalent to, the 'African big five' – African Buffalo (*Syncerus caffer caffer*), African Elephant (*Loxodonta africana africana*), Leopard (*Panthera pardus*), Lion (*Panthera leo leo*) and White Rhinoceros (*Ceratotherium simum simum*) – but extends to other iconic wildlife that may be cryptic, generally scarce, endangered or endemic to the protected area. Thus, the consequences of climate change for protected areas go beyond the strategic conservation of wildlife in that the economic viability of many protected areas tends to be dependent on its tourism appeal, which is in turn (in part) dependent on the persistence of iconic wildlife (Saayman & Saayman, 2017). Despite this nexus, the consequences of climate change for the potentially complex relationship that exists between the (i) protected area, (ii) the existence therein of iconic but potentially damage-causing wildlife that may be vulnerable to the impacts of climate change, (iii) the wildlife tourism industry, and (iv) neighbouring communities, remain, in many respects, under-researched if not uncharted and untested territory (Stone & Nyaupane, 2018).

Against this backdrop, this paper examines potential consequences of climate change at the interface between the protected area, its tourism appeal and neighbouring communities – with a view to gaining an increased understanding of the complexity of climate change-orientated decisions for conservation agencies and protected area managers. Although the effects of climate change on African Wild Dogs (*Lycaon pictus*) are often difficult to determine and may vary (see Box 1), the introduction of a pack of 14 individuals into Tembe Elephant Park , KwaZulu-Natal, South Africa in 2010, provides an opportunity to explore decision-making at this interface. The traditional behaviour of African Wild Dogs is thus used as a proxy for potentially damage-causing species that may be displaced from, or break out of, small protected areas, such as TEP, as a consequence of the impacts of climate change.

Bright eyed wild dog enjoying the early morning sun © Andy Blackmore

Box 1

The ways in which, and degrees to which climate change influences Wild Dogs, and the anticipated net effect of climate change on the conservation prospects of the species, are gradually becoming clearer – but are still surrounded by uncertainty. As highly mobile animals, Wild Dogs appear to possess relatively few of the traits that typically make species vulnerable to climate change (Bellard et al., 2012; Pacifici et al., 2015; Woodroffe et al., 2017; Rabaiotti & Woodroffe, 2019).

Wild dogs have a habit of moving long distances and ranging widely, with such movements dictated by the availability of prey species and the presence of other large carnivores (Woodroffe, 2011; Darnell et al., 2014). In addition, fluctuations in movements and the population size of prey species and other predators exacerbated by the influence of climate change (e.g., through extreme weather events and disease) can be expected to correspond to increased mobility of Wild Dogs, including increased attempts to move beyond protected area boundaries. One of the key consequences of Wild Dogs escaping from a protected area is the predation of livestock by this species and the concomitant human–wildlife conflict this causes (Nyhus, 2016; Fraser-Celin et al., 2018; McNutt et al., 2018).

This study is grounded in challenges currently experienced by protected area managers and conservation agencies and uses these to extrapolate to future scenarios in which climate change manifests itself as described above, thus intensifying these challenges (van Kerkhoff et al., 2019).

TEMBE ELEPHANT PARK

The 30,000 ha Tembe Elephant Park (TEP) (Figure 1) is located on the undulating Maputaland Coastal Plain within South Africa on the southern Mozambican border and was established principally to conserve a representative example of the locally occurring population of African Elephants (Ferguson & Hanks, 2010; Blackmore, 2014). Subsequently, Lion and Black (*Diceros bicornis minor*) and White Rhinoceros have been introduced to transform TEP into a big five wildlife viewing destination. Floristically, the park comprises a mosaic of wooded hygrophilous grasslands, reeded wetlands, coastal forest and the endemic sand forest (Mucina & Rutherford, 2006). In addition to the species mentioned, TEP has an abundance of prominent wildlife such as the Greater Kudu (*Tragelaphus strepsiceros strepsiceros*), Nyala (*Tragelaphus angasii*) and Impala (*Aepyceros melampus melampus*), Common Warthog (*Phacochoerus africanus*), Cape Giraffe (*Giraffa camelopardalis*) and Hippopotamus (*Hippopotamus amphibius*) (EKZNW, 2018).

Figure 1. Location of Tembe Elephant Park within South Africa

TEP currently has two community/private co-owned luxury safari lodges, and there is a prospect of a third being built in 2021/2. Given that tourist occupancy of the lodges appears to be directly related to the scenic and wildlife attractiveness of the protected area, it is natural for the community to appreciate that the profits derived from the lodges (the primary source of the financial benefit flowing to them) depend on the continued existence of wildlife, and, in particular, charismatic animals such as the big five – as well as Wild Dogs (Di Minin et al., 2013). Needless to say, the COVID-19 pandemic has interrupted the revenue from the lodges.

Human occupation of this surrounding landscape generally consists of sparsely distributed single households or small clusters. Three relatively densely populated areas occur near the southern boundary of the park along or in close proximity to the national road. The primary activity undertaken by these communities is livestock husbandry and subsistence agriculture.

THE MOTIVATION FOR THE INTRODUCTION OF AFRICAN WILD DOG

Notwithstanding the introduction of Lion and the existence of Hyena (*Crocuta crocuta*) and Leopard, the Nyala and to a lesser extent other antelope, have increased in numbers to a point where sensitive vegetation types (e.g. endangered sand-forest) are being negatively impacted by browsing pressure from these species (Ferguson & Hanks, 2010). Based on this situation and despite the presence of other large predators, the conservation management authority determined that sufficient prey was available for the protected area to sustain at least nine Wild Dogs (Unpublished internal memorandum, 2010). The primary motivation for the introduction of this species to TEP concerned the conservation status of Wild Dogs in South and Southern Africa and the boosting of the attractiveness of the protected area for tourism.

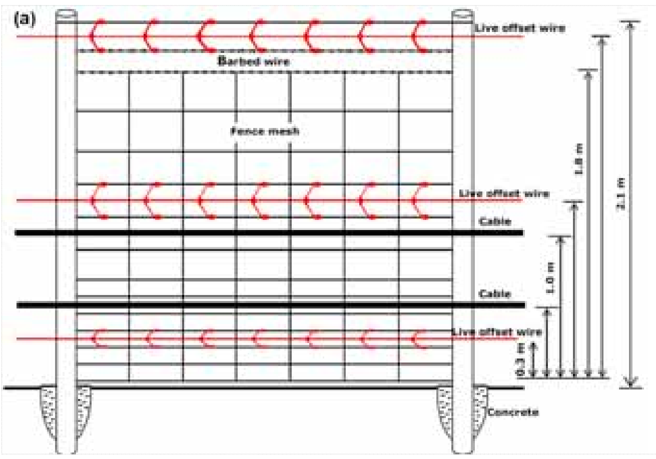
DAMAGE-CAUSING WILDLIFE

In the context of this paper, wildlife that leave the protected area and thereafter damage people's physical property, predate on livestock, cause or increase the probability of disease transfer to domestic livestock, or are a nuisance or pose a direct threat to human life are considered to be damage-causing animals (DCA) (VerCauteren et al., 2018). This can result in what is commonly referred to as 'human–wildlife conflict', when the two (damage-causing wildlife and humans) fail to co-exist harmoniously, and the damage caused undermines the livelihoods and well-being of the people affected. The outcome of such circumstances can be twofold. The first is a call for the removal or extermination of the DCA (Treves, 2009) and the second is to seek reasonable compensation from the conservation management authority for the damage caused (Nyhus, 2016).

The original response to both DCA and the general loss of wildlife from protected areas in South Africa was to erect fences to limit the movement of animals and people across the boundaries of the protect areas. The design of the fences, over time, has been improved to become more effective at retaining DCA and other wildlife (see Figure 2). These improvements have included the addition of a trip-cable, particularly for the retention of Rhinoceros and Hippopotamus, and for other DCA (e.g. Elephant, Lion, Hyena), an electrified fence with various electrified offset wires perpendicular to the fence. Furthermore, for those DCA that traditionally burrow under fences (including Wild Dogs), an electrified offset tripwire at the base of the fence, or a limited distance away from the fence, is often used to deter these animals from this habit (Figure 2b).

Despite the establishment of such electrified boundary fences, DCA and other wildlife continue to breakout (Prager et al., 2012). Such breakouts may occur when fences are rendered ineffective through natural processes (e.g. flood events, treefalls, Elephant damage, and collision damage by large animals), human-induced damage (e.g. theft, cutting of fences by poachers, vandalism), lack of maintenance, or mechanical or electrical failure or inconsistent electricity supply (Ferguson & Hanks, 2010; Davies-Mostert et al., 2013). These breakouts may significantly impact households in neighbouring communities.

The net result of these predators (Wild Dogs) and other potential DCA, and the damage caused in the absence of adequate and timely compensation, is (even for a single breakout) potentially catastrophic for the individual households affected and also tends to affect the rural community as a whole (Khumalo & Yung, 2015; Bond & Mkutu, 2018). Withholding or delaying the payment of compensation not only impoverishes those affected, but increases the persecution of DCA by affected people and creates or aggravates a negative attitude of rural communities towards the protected area (Rakshya,



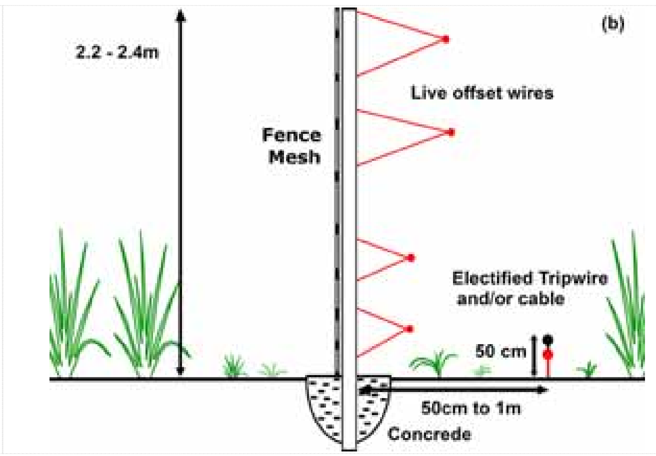


Figure 2. Two examples of a protected area fence configuration used in South Africa to retain dangerous wildlife. Both examples employ energised (live) offset wires and steel cables and fencing mesh (diagrams adapted from (a) Ezemvelo KZN Wildlife, Undated; and (b) Potgieter et al., 2012).

The reception to the community-owned lodge. The lodge goes beyond mere employment of members from the neighbouring community but creates careers for those who have an interest in tourism hospitality. © Henri Frenken

2016). This, in turn, risks precipitating a loss in political support for protected areas and biodiversity conservation as a whole (Treves, 2009). From a Wild Dog conservation perspective, reintroductions of the species make sense mainly for areas that are securely fenced, and if breakouts can be foreseen, where a proactive strategy is in place to avoid preventive or retaliatory killing of this species by affected or potentially affected people outside the protected area (Gusset et al., 2008).

The potential consequences for neighbouring communities that arise from the introduction and conservation of DCA in protected areas are, therefore, a particularly relevant consideration for conservation authorities and protected area managers. It is sensible not to take decisions to either introduce or maintain DCA in a protected area without considering the interests and well-being of people that may be affected (Barrow & Fabricius, 2002). This is particularly relevant in view of the anticipated consequences of climate change highlighted above.

BENEFITS AND NEIGHBOURING COMMUNITY ACCEPTANCE

While the flow of benefits arising out of protected areas may temper or offset the residual resentment arising out of the impacts of DCA on rural communities (Snyman, 2012), these benefits together with the compensation may not be sufficient to maintain meaningful tolerance of DCA, let alone a peaceful co-existence. This understandable outcome would primarily appear to result from community members enduring direct personal risks which are disproportionate to the benefits they derive from the protected area, and those risks taken by the conservation agency or the management authority for keeping DCAs the protected area. This is particularly relevant for community members deriving no tangible benefits from the existence of the DCA. It is, therefore, important for the community (including those members that have suffered or risk DCA-related losses) to gain tangible benefits and an interest in the existence and conservation of the DCA. This is primarily achieved when (1) the protected area provides meaningful employment to community members to manage the protected area and particularly its DCA, and (2) the community develops or is a primary shareholder in nature-based tourism enterprises such as the establishment and management of lodges and guided expeditions for visitors to experience the DCA and other wildlife. In these circumstances, the removal of a population of DCA would produce a reduction in tourism attractiveness, which would in turn lead to a reduction in income and employment generated for the community by the protected area (Lapeyre, 2011).

A BRIEF SUMMARY OF THE WILD DOGS CONUNDRUM

The introduction of Wild Dogs, on both conservation and ecological grounds, is best not undertaken without comprehensive consultation with neighbouring communities, given the risk to livestock should they escape (Whittington-Jones, 2015). In the case of TEP, this consultation and provision of information on the importance of Wild Dogs was originally undertaken by the NGO Endangered Wildlife Trust, on behalf of the conservation management authority, and gained the community's support for the introduction (Whittington-Jones, 2015). The 14 Wild Dogs were subsequently released into the park (Whittington-Jones, 2015) and were recorded to have produced one litter of pups shortly after release.

Some five years following their introduction in 2010, the management authority received complaints of livestock loss apparently caused by Wild Dogs that had escaped (Hanekom, pers. com., 26 June 2020). The opposition of the neighbouring community to the Wild Dogs resulted in the conservation management authority revising its position on Wild Dogs in TEP, which culminated in the Wild Dogs being recaptured and relocated to another protected area. This decision was further underpinned by a continual reduction in the authority's conservation budgets (see, for example, Cundill et al., 2013) and the concomitant reduction in the availability of DCA compensation funds.

The first author was witness to this decision being challenged by the management of one of the lodges in TEP, who argued that the presence of Wild Dogs was paramount for tourism attractiveness and the growth of this industry within TEP. The lodge manager argued that the financial benefits, which were to a certain extent linked to the presence of Wild Dogs in the park, accrued to the neighbouring community as the main economic partner in the lodges, but had not been given sufficient weight in the decision taken by the conservation management authority to remove the animals from TEP. When these arguments were presented at a Tribal Authority Meeting (18 September 2018, Tembe Tribal Court, Nkwangase, KwaZulu-Natal, South Africa), describing the various financial benefits to the community from gate entrance fees, lodge occupancies, employment and career development, the community requested the management authority to secure additional Wild Dogs and release these into TEP. This decision by the community was taken on condition that community members impacted by any escaped Wild Dogs would be adequately compensated for stock losses incurred.

Given the financial constraints of the conservation management authority and the reduction in its ability to pay compensation, the lodge manager gave his assurance that he would provide (independent of the community's financial interests) the necessary compensation in those instances where the conservation management authority determined the loss of livestock was caused by Wild Dogs that had escaped TEP. Such assurance was offered on the assumption that the overall financial benefits generated by the presence of Wild Dogs in TEP far outweighed the post compensation residual costs incurred by community members as a result of stock loss.

Four Wild Dogs were subsequently re-released into TEP as a result of the multilateral partnership that was forged between the neighbouring community (through their traditional council), the tourism industry in TEP, and the conservation management authority.

CLIMATE CHANGE AND CONSERVATION DECISIONS WITHIN PROTECTED AREAS

There is little argument against the notion that climate change is going to have a lasting impact on protected areas and that this impact will occur at a rate not readily detectable at the scale at which management of these areas tends to occur, extreme weather events aside. The response of wildlife, and in particular DCA, to such climate change effects is likely to be subtle and not easily differentiated from the stochastic responses of these species to perturbations associated with protected area

Collared adult wild dog so that the movements of individuals and the pack can be monitored and alerts Park Management of a possible break out if the wild dogs dwell along the fence line and enables to wild dogs to be located should they escape. © Catariné Hanekom management, climatic events or tourism (Bennett et al., 2011). Despite this uncertainty, conservation management decisions will still need to be taken (Carvalho et al., 2011).

While there are many proponents of adaptive management and decision-making as a means for dealing with climate change uncertainty (Williams & Brown, 2016), such a strategy may not be appropriate in all circumstances. The same applies to decision-making that arises from rigorous hypothesis testing. For instance, where a wildlife population faces extinction or where there is a high risk to human health and well-being as a result of DCA moving out of protected areas, an immediate decision that may have a long-term consequence is advocated. In such situations, the management authority or conservation agency must have sufficient policy flexibility to avert imminent problems from arising, preferably based on a proactive, anticipatory, risk-averse planning and evidence-based decision-making strategy (Blackmore, 2014; van Kerkhoff et al., 2019). Although a pragmatic or command-and-control approach to conservation decisions may be suitable for certain aspects of protected area management (e.g. maintenance of the genetic integrity of wildlife, destruction of a DCA), this approach is becoming increasingly less desirable, if not inappropriate, for decisions that have consequence for the benefits or risks arising out of protected areas for neighbouring communities. This is particularly relevant when communities and the tourism industry have an economic stake in the protected area and the presence of certain species. Decision-making by protected area management authorities in response to the unfolding impacts of climate change is, therefore, becoming significantly more complex as communities become owners and economic partners in protected areas and the conservation of wildlife. The COVID-19 pandemic and the associated cessation in domestic and global tourism markets as a result of travel bans has brought into play an additional dimension of complexity and vulnerability regarding this economic relationship between the community and the protected area (Newsome, 2020).

CONCLUSION

Within small fenced protected areas, the impacts of climate change are difficult to discern, let alone predict with any degree of certainty, which complicates anticipatory and adaptive management to mitigate such impacts. By drawing solely on the behaviour of African Wild Dogs as an indicative surrogate for carnivores and other potentially damage-causing wildlife that are likely to be displaced by climate change, speculative insights are gained into the potential consequences of climate change at protected area boundaries. Given the attractiveness of Wild Dogs, this focus enables further insights regarding the importance of iconic wildlife to nature-based tourism and the financial benefits they bring to the protected area and neighbouring rural communities.

If climate change exacerbates the prevalence of damage-causing wildlife escaping protected areas into neighbouring communities, then an increase in persecution of these species can be expected alongside a reluctance by the communities concerned to support introductions of such species from elsewhere. The persistence of resentment even after damage caused by escaped wildlife has been compensated may be prevented or overcome when neighbouring communities have a substantial and meaningful beneficial interest in the introduction and conservation within the protected area of damage-causing and/or iconic wildlife (which may include species that are cryptic, generally scarce, endangered or endemic). The growing trend of rural communities playing a proactive role in and becoming economically dependent on protected areas, results in complex and intertwined relationships between the stakeholder community, wildlife tourism industry and the conservation agency involved. The conservation management of wildlife in a changing climate, especially with regard to small fenced protected areas, therefore requires more than a simple decision by conservation agencies to relocate species to more suitable habitats. Rather, protected area management authorities should take into consideration the relationship between the parties involved before decisions are taken in response to climate change or in response to any other conservation imperative. A degree of flexible governance is required to do justice to the specific nuances where there are overlapping and interdependent benefits and commercial interests arising out of the protected area for neighbouring communities and the wildlife tourism industry.

It would seem advisable for protected area managers and conservation agencies to incorporate into the management of protected areas a proactive strategy to mitigate and adapt to the impacts of climate change. To increase the chances of success, such a strategy should, as a minimum, encompass: (1) increasing the awareness and understanding of both neighbouring rural communities and the associated tourism industry of the latent consequences of climate change for the protected area concerned and its wildlife; (2) empowering both these stakeholders to adapt their expectations and business plans to take into consideration the impacts of climate change on both the protected area and its tourism attractiveness; (3) mechanisms to enhance the effectiveness of boundary fences to retain wildlife, in particular potentially damage-causing animals, should they become increasingly prone to escape under the influence of climate change; and (4) jointly determining with the community and resident tourism industry the, yet to be researched, indicators or thresholds (not limited only to escape frequency) to determine when a species would need to be removed from the protected area and relocated to more suitable habitat, whether as a result of climate change or otherwise.

ACKNOWLEDGEMENTS

Ms Catariné Hanekom, Ezemvelo KZN Wildlife's District Ecologist for Tembe Elephant Park, is thanked for providing information on the Wild Dogs in this protected area.

AUTHOR STATEMENT

AB conceptualised the study, performed the principal analysis, and drafted most of the manuscript. AT contributed research and drafted parts of the manuscript. The ideas, arguments and opinions expressed in this article are the authors' own and do not necessarily represent those of Ezemvelo KZN Wildlife.

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RESUMEN
El cambio climático tendrá impactos crecientes en las especies y en la composición del hábitat de las áreas protegidas, aunque es difícil predecir con exactitud las repercusiones, especialmente en las áreas más pequeñas. Esto plantea interrogantes a las autoridades de gestión, no solo con respecto a la integridad ecológica de las áreas protegidas, sino también con respecto a la fauna silvestre que "escapa" y ocasiona daños.
Tradicionalmente, las áreas protegidas son responsabilidad primordial de las autoridades de gestión, pero la introducción de fauna y flora carismática y potencialmente dañina afecta los intereses comerciales superpuestos y compartidos de la industria turística y las comunidades rurales vecinas. Conforme se manifiesta el cambio climático, es probable que la compleja relación entre estas tres partes interesadas se vea afectada por la mayor frecuencia de los daños ocasionados por la fauna silvestre cuando intenta salir o expandir sus áreas de distribución más allá de los límites del área protegida. Se concluye que es probable que un planteamiento laissez-faire por parte de las autoridades de conservación o los administradores de las áreas protegidas con respecto al cambio climático plantee problemas, especialmente en lo tocante a las relaciones con las comunidades rurales vecinas. Se requiere una mayor conciencia de los efectos del cambio climático entre todos los interesados directos, incluidos los organismos de conservación, la industria del turismo y las comunidades rurales vecinas, y la gestión de la fauna silvestre que se escapa debería ser una responsabilidad conjunta basada en un acuerdo contractual entre dichos interesados.

RÉSUMÉ
Le changement climatique aura un impact progressivement croissant sur les espèces et la composition de l'habitat des aires protégées, même si cet impact précis est difficile à prévoir, en particulier dans les petites zones. Cela soulève des questions pour les autorités de gestion, non seulement en ce qui concerne l'intégrité écologique des aires protégées, mais aussi en ce qui concerne la faune qui « s'échappe » et cause des dommages. Les aires protégées sont traditionnellement sous la responsabilité première de leur autorité de gestion, mais l'introduction d'une faune charismatique qui puisse potentiellement causer des dommages impacte également des intérêts commerciaux de l'industrie du tourisme et des communautés rurales voisines. A mesure que le changement climatique se manifeste, la relation complexe entre ces trois parties prenantes est susceptible de devenir tendue en raison de la fréquence accrue des dommages causés par les espèces sauvages lorsqu'elles tentent de quitter ou d'étendre leur territoire au-delà des limites de l'aire protégée. Nous concluons qu'une approche laxiste face au changement climatique par les autorités de conservation ou les gestionnaires d'aires protégées est susceptible de poser problème - en particulier en ce qui concerne les relations avec les communautés rurales voisines. Une plus grande sensibilisation aux impacts du changement climatique parmi toutes les parties concernées est nécessaire, y compris les agences de conservation, l'industrie du tourisme et les communautés rurales voisines, et la gestion de la faune échappée devrait devenir une responsabilité conjointe fondée sur un accord contractuel entre ces parties prenantes.

TOURIST USE AND IMPACT MONITORING IN THE GALÁPAGOS: AN EVOLVING PROGRAMME WITH LESSONS LEARNED

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ABSTRACT
Timely and relevant monitoring of tourist use and impacts is increasingly important for the adaptive management of protected area tourism. However, programmes initially set up for monitoring need to swiftly respond and adjust to emerging trends and patterns in visitation and concomitant conservation and community ramifications. Few published papers have shared successes, failures and challenges of specific tourist monitoring programmes in protected areas. This paper addresses this gap by summarising the multi-stage development of the tourist use and impact monitoring programme in the iconic Galápagos National Park and sharing the major lessons learned. From the 1960s to the present, we identified four major stages of monitoring programme development driven by a variety of forces, from the early research on tourist impacts on wildlife to the current monitoring programme that involves significant public participation and technology applications in implementing indicators. This summary should be of value to other protected areas, especially those that are accommodating fast-growing tourism, building monitoring programmes or contemplating adjustments to their programmes due to changing management challenges, information needs or capacity for monitoring implementation

Key words: Galápagos National Park; tourism; visitor sites; visitor impacts; monitoring program; indicators; SIMAVIS

INTRODUCTION
Tourism is a potentially powerful tool for biodiversity conservation in protected areas and beyond. Besides tourism's contributions to conservation finances and the local economy, transformative visitor experiences in protected areas may cultivate pro-environmental behaviours and concomitant public support for conservation (Hvenegaard & Dearden, 1998; Halpenny, 2010). Indeed, tourism is an integral component in the UN's 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns in support of multiple 2030 Sustainable Development Goals (UNEP, 2020). However, there are concerns about whether tourism's positive impacts are offset by its contributions to greenhouse gas emissions (Gössling, 2002) and its effects on landscapes and biodiversity (Newsome et al., 2012; CBD, 2016). These concerns are acute in iconic protected areas where unsustainable growth of tourism is a reality, sometimes further compounded by unsustainable population growth and subsequent resource shortages (Pizzitutti et al., 2017).

Timely and relevant data are essential to account for tourism's net impacts. Current global and national guidelines all emphasise the integral role of monitoring in the effective management of visitors and tourism in protected areas toward sustainability and desired outcomes (CBD, 2015; Leung et al., 2018; IVUMC, 2019). Effective monitoring programmes allow managers to detect trends and early warning signs while evaluating the efficacy of management actions (Miller et al., 2012). Such programmes are particularly valuable if they are affordable and sustainable over time. In this paper, we present a case study of the Galápagos Islands with a focus on the environmental pressures associated with tourist use and activities. With the terms 'monitoring' or 'monitoring programme', we refer to systematic data collection on: 1) the characteristics of tourism visitation, such as the amount and distribution of use and tourists' behaviour, and 2) the natural resource conditions at or near tourist sites where the use pressure is considered to potentially compromise the resource conditions.

No long-term monitoring programme can be done right the first time; it is inevitably a learning and adaptive process through which the initial monitoring indicators and protocols are refined with new information and lessons learned from implementation (Lindenmayer & Likens, 2009). Tourist use and impact monitoring is no exception. In Yosemite National Park, for example, a 5-year pilot monitoring programme was designed to explore and evaluate indicators for final selection for long-term implementation (YNP, 2010). Even after this, some adjustments were still necessary due to changes in impact issues, management concerns and staff capacity (YNP, 2020). Few published papers have evaluated or reflected on the successes, failures and challenges of tourist monitoring programmes in protected areas. These experiences would be valuable for protected area managers to set realistic expectations and proactively address challenges, as there are increasing calls for consistent monitoring as a key best practice for managing protected area tourism (CBD, 2015; Leung et al., 2018).

With respect to the evolutionary nature of things, no place is more fitting than the Galápagos Islands, Ecuador (Quiroga & Sevilla, 2017). Evolution and natural selection over long time scales have been well studied in this archipelago, but less is known about the management and monitoring of tourism. This paper aims to illustrate the evolution of tourism monitoring activities in the Galápagos' protected areas. We review

Endemic wildlife and their interactions with tourists in multiple visitor sites, and a visitor education sign on the wildlife distance rule, in the Galápagos protected areas © Yu-Fai Leung past and present monitoring efforts while highlighting the challenges, lessons learned and future needs to sustain and integrate monitoring efforts into decision-making processes. We believe that this example may facilitate dialogue among protected area managers elsewhere as they are conceiving or designing monitoring programmes for the first time, having to adjust current monitoring programmes or building capacity to sustain monitoring efforts over time. This dialogue is particularly crucial for iconic protected areas or UNESCO World Heritage Sites where fragile natural resources are increasingly threatened by unsustainable tourism growth.

THE GALÁPAGOS CONTEXT

The Galápagos archipelago possesses some of the world's most unique and endemic fauna and flora due to its isolation and active volcanism. Most of the archipelago's landscapes and ecosystems are protected in one or multiple forms. The Galápagos Islands were declared a National Park (GNP) in 1959, which was inscribed into the world's first UNESCO World Heritage Site in 1978. A total of 7,995 sq. km of terrestrial ecosystems, about 97 per cent of the archipelago's land area, are protected while the Galápagos Marine Reserve, declared in 1998, adds about 133,000 sq. km of marine ecosystems (Figure 1).

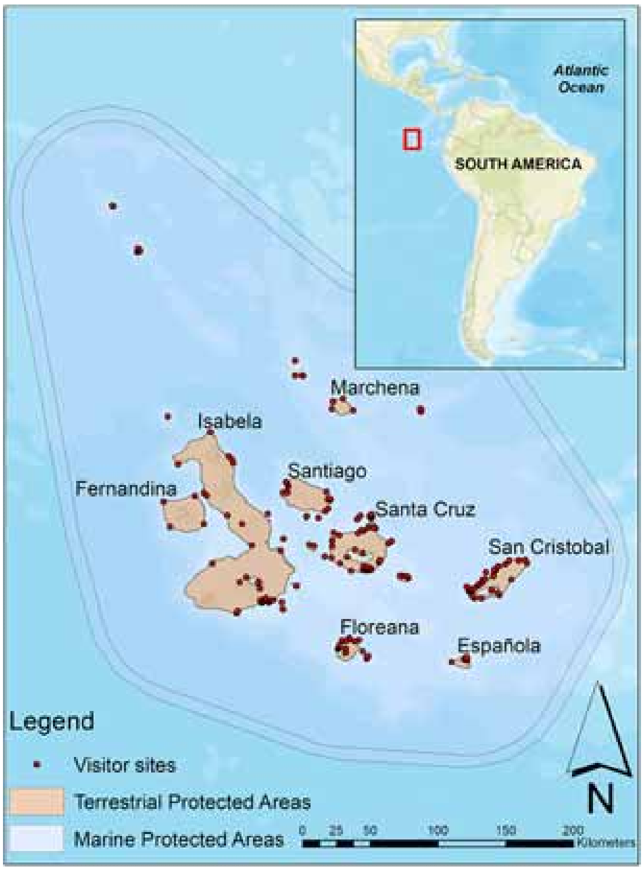

Figure 1. Visitor sites of the Galápagos National Park and Marine Reserve

In the Galápagos Islands, tourism started in the late 1960s with only two flights per week, mainly charters for the Lindblad Company operating two cruise ships, and only very few small island-based vessels were available for charter (Epler, 2007). In the 2010–2019 period, the Galápagos Islands recorded a total of 2.2 million visitors with steady growth rates of 5–9 per cent per decade since 1980 (Figure 2). Concerns of overtourism in the Galápagos Islands have been repeatedly raised, and such concerns have been substantiated by different evaluations and scenario analyses (Pizzitutti et al., 2017; Lethier & Bueno, 2018; Mestanza-Ramon et al., 2020). In fact, discussions about caps on tourist numbers are not new for the GNP as several specific caps have been proposed over time (Cifuentes, 1992). However, as Galápagos residents and the national economy depend significantly on tourism incomes, none of the proposed tourist caps was successfully implemented by the government, although the discourse has motivated the development of different management strategies intended to minimise impacts (McFarland & Cifuentes, 1996).

The Galápagos Islands comprise a total of 85 terrestrial and 98 marine visitor sites (Figure 1). To manage the terrestrial sites, the GNP has established a specific tourism zoning system with six different categories. These tourism categories vary from easily accessible recreation sites with infrastructure and services, to wild nature sites where access is possible only after several days of navigation with minimal infrastructure and no service beyond landing docks and trail markings. Using this zoning rationale, the GNP organises tour activities by modalities that determine itineraries (i.e., where to go and when) and activities (i.e., what to do) allowable for visitor sites in different zones. In total, there are six major tour modalities organised by different itineraries that range from daily visits to 15-day cruises. These itineraries are currently assigned to 162 tour operators which run big and small operations with vessels from 10 to 100 passengers.

In the Galápagos Islands, around 700 specially trained and certified guides provide guiding services to tourists as freelancers or through tour operator companies. It is not an overstatement that besides their educational role, these tour guides are essential custodians of the GNP not only by ensuring tourists' compliance to the GNP rules, but also by collecting data for GNP's tourist

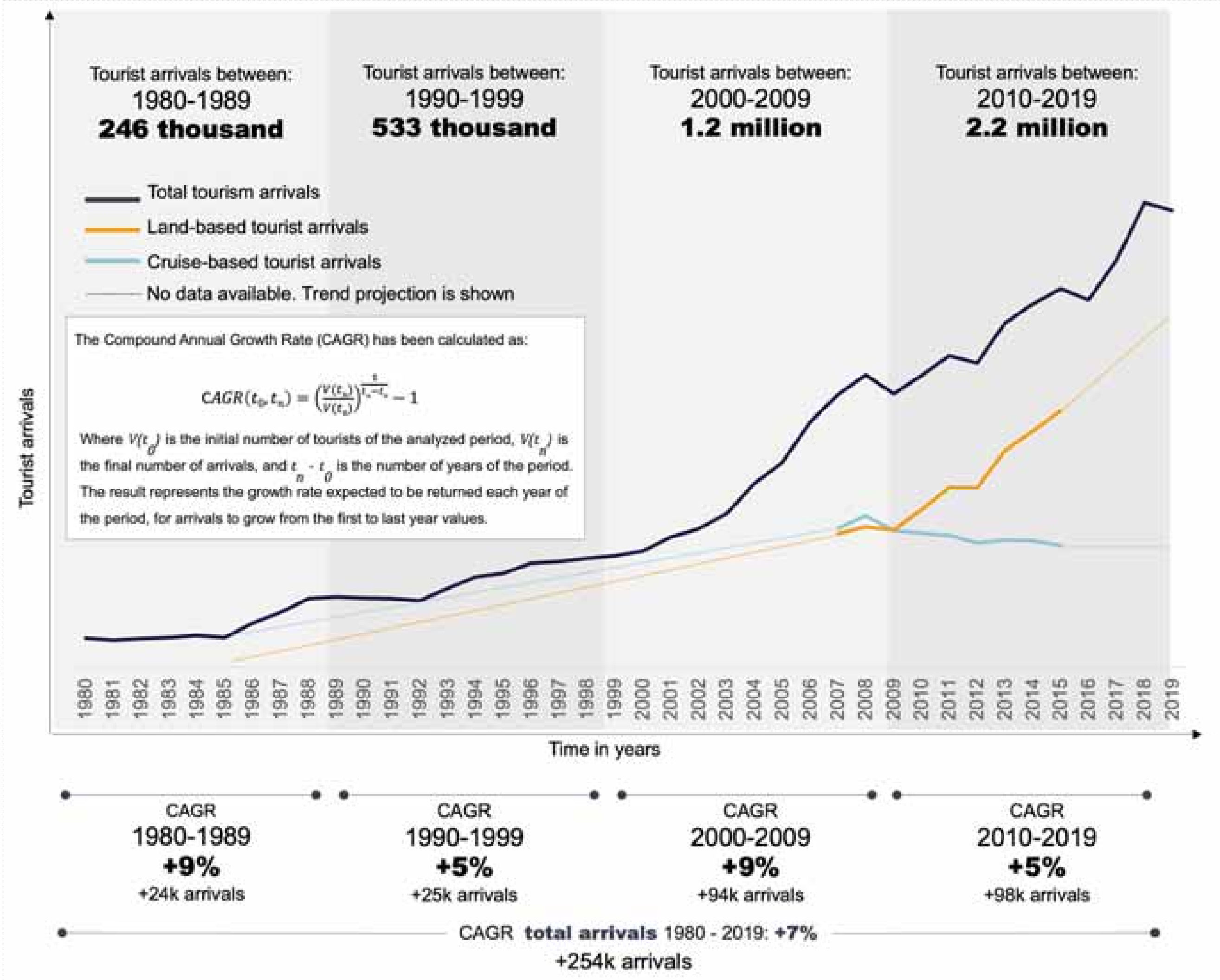

Figure 2. Tourist arrivals to the Galápagos Islands between 1980 and 2019, with Aggregation and Compound Annual Growth Rates (CAGR) shown for each decade

A certified park ranger presenting the geological history of the Galápagos Islands to his tourist group on the Bartolomé Island © Yu-Fai Leung

monitoring programme (Observatorio de Turismo de Galápagos, 2019).

Since tourism started in the archipelago, it has represented an important and often contentious matter for the Galápagos protected area authorities and the key stakeholder groups[1] (Pecot & Ricaurte-Quijano, 2019). This triggered the development and adoption of an array of visitor management frameworks and monitoring actions. However, managers at the GNP, as in many other protected areas, found it challenging to integrate monitoring tasks into the management routine, or to tap into the park's extensive scientific programme for precise data to meet managerial needs. To date, these challenges persist while the GNP struggles to adapt its management efforts to the continual growth of tourism. The following section summarises these efforts and illustrates how the Galápagos' monitoring programme has adapted to fast-changing management conditions.

TOURIST USE AND IMPACT MONITORING: THE EVOLUTIONARY STAGES

1960–1989: Early research as a foundation for management and monitoring

Since the Galápagos Islands were first conceived as an exotic tourism destination, scientists were attracted to the archipelago for its ample research opportunities. In 1966, an international group of consultants proposed the first strategy for park and tourism management (Grimwood & Snow, 1966). At this first stage, scientists proposed and conducted the first investigations of tourism's potential negative impacts on Galápagos wildlife (Figure 3). For example, Charles Darwin Foundation[2] staff ornithologists supervised a series of student thesis projects to assess tourists' impacts on seabird breeding[3] (McFarland & Tindle, 1976). Another study conducted by WWF in 1974 examined elevated tourist-caused stress through heart-rate increase in four seabird species: Frigate Birds (Fregata magnificens), Blue-footed Boobies (Sula nebouxii), Waved Albatross (Phoebastria irrorata) and Swallow-tailed Gulls (Creagrus furcatus) (Jungius & Hirsch, 1979).

As one co-author (Reck) observed, the establishment of trail-perpendicular transects in the eighties to monitor tourism-induced long-term population changes failed because the local abundance of seabirds suffered extreme natural fluctuations and no short-term tourism impact could be associated. There was no enthusiasm to invest in long-term data gathering without the possibility of short-term publications (Reck, 2017). However, as far as tourism monitoring is concerned, these early studies helped build the foundation of subsequent monitoring efforts with baseline information on specific species or visitor sites against which future conditions could be compared.

1990–2000: The first tourism monitoring efforts

As tourism was growing and diversifying in the Galápagos, the interest in learning more about the negative impacts of the tourism activities on wildlife also increased. Examples of investigations developed during this period include: 1) a study on the short-term behavioural responses of three nesting birds – Masked Booby (*Sula dactylatra*), Blue-footed Booby (*S. nebouxii*) and Red-footed Booby (*S. sula*) (Burger & Gochfeld, 1993), and 2) the study of physiological responses of Marine Iguanas (*Amblyrhynchus cristatus*) to stress caused by tourism (Romero & Wikelski, 2002).

Although these studies reported mixed results on the ecological significance of tourism impacts, they confirmed the effectiveness of previously established visitor rules and guidelines, which had been integrated by tour guides into their interpretative and educational activities. A subsequent observed reduction of direct impacts, such as the extent of informal trails and the deterioration of formal trails at visitor sites attended by guides, was attributable to these efforts. These studies also contributed to comprehensive descriptions of the ecosystems in different visitor sites, setting the foundation for zoning and the establishment of management objectives to address conservation and management needs appropriately. Consequently, the carrying capacity framework proposed by Cifuentes (1992) was revised (Cayot et al., 1996), and more site specific rules and daily caps were proposed, and the

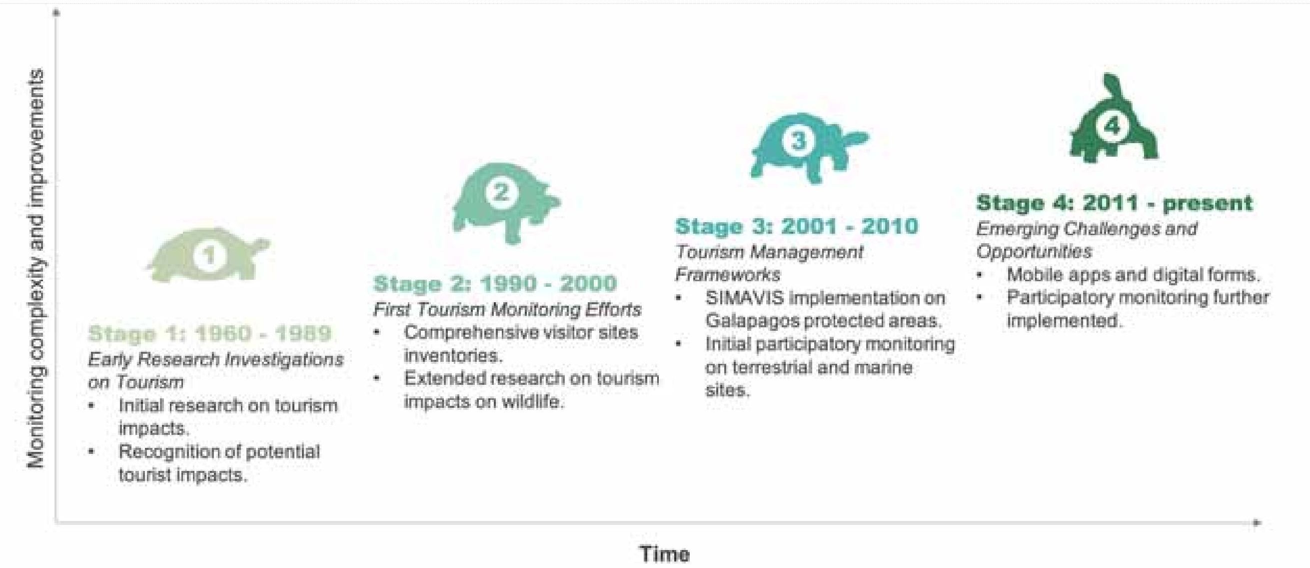

Figure 3. The development of tourist use and impact monitoring in Galápagos protected areas

Limits of Acceptable Change (LAC) framework was mentioned for the first time (Stankey et al., 1985).

Despite the contributions, research studies in this stage primarily followed elaborate procedures and protocols. Managers were not typically engaged in data collection or analysis/reporting processes. Furthermore, financial constraints and the specific academic skills required to conduct these studies prevented managers from translating the research procedures into routine monitoring practices in the Galápagos. The apparent reduction of tourism impacts also led to a lower priority of such studies among researchers at the time.

2001–2010: Tourism use and impact monitoring as a part of management frameworks

Along with the implementation of management frameworks in the Galápagos, tourism monitoring began to take shape as an intentional and continuous process (Naranjo & Izurieta, 2015). This resulted in the first monitoring programme piloted by the national park between 2000 and 2004 (GNP, 2006). This preliminary programme, however, was not tied to the Limits of Acceptable Change (Stankey et al., 1985) or any other management framework and consequently, it had little influence on management decision making.

Cruise-based tourism did not increase significantly during this decade, but local-based activities started to expand, resulting in more intensive use of recreation sites near the ports (Mestanza-Ramon et al., 2020). Rapid increase in tourism was exacerbated by deficient application of tourist carrying capacity values, prompting the GNP's fear that the present tourism management scheme was ill prepared for the soaring pressure even though it was considered efficient so far. Such concerns and circumstances prompted the development and systematic implementation of the Visitor Management System of the Galápagos (SIMAVIS in Spanish) in 2008 (Reck et al., 2015).

SIMAVIS is an adaptive management framework designed to replace fixed carrying capacity concepts but recognise those effective management techniques adopted by GNP so far. It was built on similar visitor management frameworks such as the Limits of Acceptable Changes (LAC), Recreation Opportunity Spectrum (ROS) and Visitor Experience and Resource Protection (VERP) developed in the United States (McCool et al., 2007; Leung et al., 2018). The SIMAVIS framework was adapted to the particular management conditions of isolated areas in which the use of visitor sites, distributed as a network in the archipelago, is determined by the type of terrestrial and marine activities and the type of tourism modality that give access to different sites according to specific itineraries (Reck et al., 2010 and 2015).

Essentially, SIMAVIS integrates and addresses six key elements regarding tourism in the Galápagos protected areas: zoning, acceptable number of visitors, itineraries, management strategies at visitor sites, tourism monitoring, and communication and interpretation. The monitoring rationale proposed by SIMAVIS drew on a group of quantifiable ecological, physical, social and managerial indicators. It also established the desirable conditions and the limit of acceptable changes for each zone and visitor site (Reck et al., 2008 and 2010).

Monitoring procedures, mainly for terrestrial visitor sites, incorporated a participatory approach supported by the protected area staff, academia, NGOs and tour guides, with the aim of reinforcing communication and enhancing participation among stakeholders, particularly tour guides. Monitoring of soil erosion, visitor-created informal trails, tourism congestion at specific sites, acceptable visitor capacity and visitor behaviour were implemented, giving important insights into the management of tourism in the Galápagos (Reck et al., 2010). Consequently, the monitoring results triggered the revision of itineraries under different tourism modalities and the adoption of compulsory management measures by the GNP managers.

In regard to marine tourism monitoring, one project related to the tourist use of marine environments is the most notable. Following the creation of the Galápagos Marine Reserve in 1998, the Charles Darwin Foundation initiated several studies of marine tourism, particularly at diving sites (Danulat et al., 2003). In 2006, the four-country INCOFISH monitoring plan was developed and implemented for assessing the impacts of marine tourism in the Galápagos Islands. Throughout this five-year project, different marine indicators for tourism monitoring were tested. The project fostered innovations in tourism monitoring in marine settings and contributed to important baselines on marine tourist use in the Galápagos, especially diving activities (Cubero-Pardo et al., 2007; González-Pérez & Cubero-Pardo, 2010).

Despite these advances, not all tourism monitoring procedures were sustained over time in both marine and terrestrial visitor sites due to logistical, technical or funding constraints. Furthermore, data analyses were not systematically performed due to limited staff time and capacity. These limitations underscored the need for the SIMAVIS monitoring protocols to continue to adapt to the new challenges.

2011 to the present: The emerging challenges and opportunities for monitoring

During this contemporary period, tourism in the Galápagos has been undergoing significant transformation, not only in terms of further increases in arrivals, but also changes in visitors' profiles, expectations and interests. In contrast with conventional cruise visitors, a new profile of tourists showed more interest in travelling independently, with shorter lengths of stay, a preference to spend more time on sites located near the towns, and most importantly, their enjoyment of nature was unrelated to solitude. These emerging tourists' interests are creating significant management challenges, especially congestion and crowding in sites located near the ports. Such substantive changes imposed another challenge in an era in which efficient data collection and timely reporting of tourist use and impact are crucial. In response, the most remarkable innovation was the improvements introduced to the traditional Guides' Monitoring Report. This report, traditionally in a paper and handwritten format, was transitioned into the digitally-based 'Galápagos Guide Monitoring Network' (GGMN) initiative, which constitutes the most significant milestone expanding tour guides' participation in reporting activities through the use of technology (Box 1 for details).

Box 1: The use of technology in the Galápagos monitoring

Launched in 2017, the Galápagos Guide Monitoring Network (GGMN) is an online tool that supports the monitoring needs of SIMAVIS. Developed by the GNP with technical support from Observatorio de Turismo de Galápagos, the Charles Darwin Foundation, and financial and technical support from WWF Ecuador, the GGMN engages around 400 tour guides in monitoring using technology and mobile apps. This tool has dramatically increased the guides' monitoring efforts, including the number of observations and reporting (multiple observations at different visitor sites) (Figure B1).

The GGMN offers three main improvements:
1) It is 'observation centred' → It motivates guides to report observations regarding relevant tourism and conservation issues,
2) It allows visual records → photos can be uploaded to support text descriptions of specific impact issues or field encounters, and
3) It facilitates communication → the online form enables guides and the GNP authority to send feedback to each other.
The GGMN affords GNP managers full access to 1,500+ observations from most visitor sites annually, leading to: a) early threat alerts, such as an emerging invasive species, b) detection of trends, such as number of accidents, and c) historical and year-round data that help inform management actions. More details at: http://observatoriogalapagos.gob.ec/reporteguias

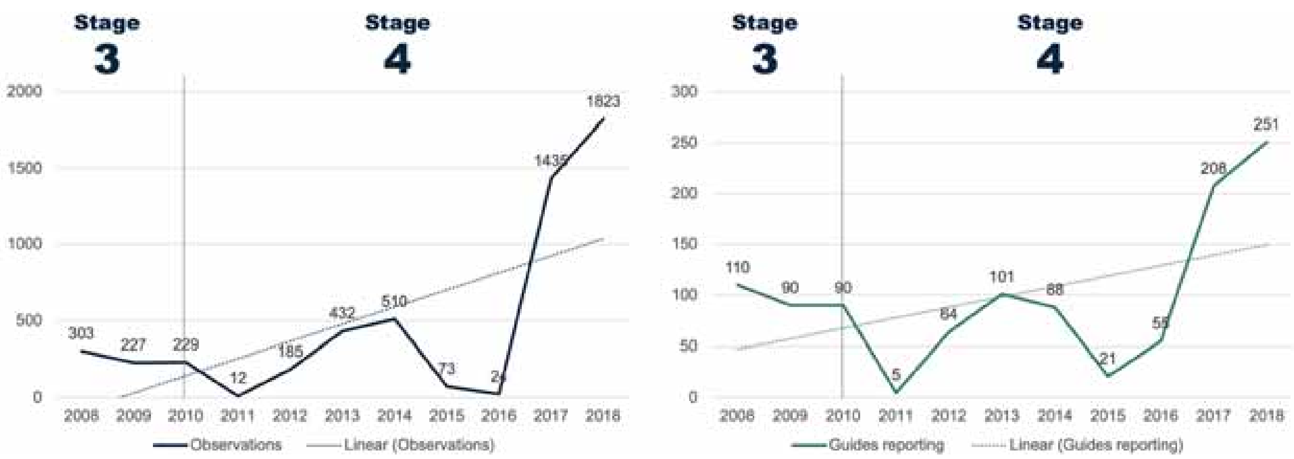

Figure B1. The number of Galápagos tour guides' observations (left) and reporting (right) annually between 2008 and 2018. (See Figure 3 and the text for the description of stages)

As the GGMN consolidated, new approaches for monitoring underwater tourism also appeared. From 2015 to 2019, the GNP in collaboration with different stakeholders carried out the DIVESTAT project – a participatory tourism monitoring effort aiming to improve understanding of divers, their profiles, underwater behaviour and impacts on the Galápagos Marine Reserve (WWF Ecuador, 2017). Supported by diving guides, DIVESTAT monitoring results have been important not only to gain a better understanding of diving tourists, but also to emphasise awareness and educational opportunities. This project is being expanded to include data collection by snorkelers, to establish a protocol of good practices and to augment ecological monitoring already carried out by the guides.

Blue-footed Booby (*Sula nebouxii*) Seymour Island, Galápagos © Marc Hockings

Following the GGMN enhancements, another major adjustment of Galápagos tourist monitoring took place when a comprehensive review of the entire SIMAVIS monitoring programme was conducted in 2017. This review led to a number of programme recommendations:

- Examine the appropriateness of monitoring procedures in order to meet the current management challenges;
- Redesign protocols and procedures for specific indicators to make them achievable;
- Propose, select and apply indicators according to zoning and site management objectives;
- Motivate participation of other stakeholders in the monitoring programme, especially tour guides; and
- Improve data collection and systematisation activities to inform decision-making processes in a timely manner.

As a result, a more participatory monitoring programme enabled by mobile technology was developed and adopted, including revised monitoring rationales, indicators, protocols and procedures (Reck et al., 2017). The revised monitoring protocols were intended to meet the urgent and fast-changing management conditions for the Galápagos protected areas by engaging managers, guides, the community, academics and volunteers. Essentially, this new protocol encourages the active contribution of different stakeholders who act as monitors of the Galápagos all year and at almost all visitor sites. Features of the ranger monitoring report tools, based on the positive results of the ongoing GGMN, were further enhanced and optimised.

Through the use of these online tools, the new ranger monitoring report is able to generate early warning alerts to inform GNP managers so they can prioritise monitoring efforts based on specific needs and objectives in order to strategically allocate resources, time, personnel and money to make monitoring more efficient. The use of mobile technology and online tools also alleviated past constraints in regard to data collection and systematisation. Consequently, the generation of timely information for managers is now possible. Furthermore, technology triggered the commitment of tour guides and rangers who felt motivated as they are contributing to decision-making and management actions. However, significant constraints still exist that limit the potential of this method to date. These include the lack of funding, the need for continued training of personnel, and limited access to technology and devices.

As most of the past GNP tourism monitoring efforts were focused on biophysical and management indicators, little attention had been paid to social indicators such as tourist satisfaction, community well-being, and cultural and educational benefits. With congestion and crowding conditions becoming more common, assessing the extent and effect of these social interactions has become crucial. In the last two years, a survey methodology has been implemented to evaluate tourist satisfaction and cultural ecosystem services provided by visitor sites near the ports at the islands of Santa Cruz and San Cristobal. Information collected includes satisfaction indicators related to the natural attributes of the site, activities carried out, the role of tour guides, number of visitors, management measures in place, and infrastructure (Cardenas et al., 2019).

Some of the social monitoring results have been incorporated into management strategies and actions for the most crowded visitor sites. One example is Las

Grietas in Santa Cruz, a series of three elongated, almost rectangular pools that cut through towering lava cliffs. During the summer and holiday season, up to 600–700 tourists were recorded per day on this small visitor site and almost one fifth of the tourists surveyed indicated that they felt overcrowded. To overcome this long-term concern which is supported by the data, the GNP is implementing a group reservation system combined with fixed scheduling for tour operators to control the maximum use levels. Other strategies include ranger patrols and educational campaigns to increase tourists' rule compliance. Building on this first step, the GNP is planning to expand monitoring of the social dimensions of visitor use experience at this and other visitor sites for the long term.

DISCUSSION AND CONCLUSIONS

As one of the world's most iconic protected areas facing the overtourism challenge, the experiences of the GNP monitoring programme are valuable for managers in other popular protected areas and World Heritage sites who are considering whether monitoring could help, or how a monitoring programme could be designed given the capacity and constraints of the protected area and its stakeholders. We have traced the challenges and adaptation of the tourist use and impact monitoring programme in the GNP from when tourism growth first became a concern among scientists and managers. The cascade from one stage to another was triggered by the recognition of information needs to support management decisions under emerging tourism dynamics.

The four-stage development of the Galápagos' monitoring programme shares some similarities with monitoring programmes in other protected areas, even though the actual timeline is different. For example, early concerns about increasing visitation and resource impacts led to individual impact studies in Yosemite during the 1970s (Marion et al., 2016). Conducted primarily by protected area scientists, these early studies generated baseline data and initial knowledge about different impacts. As visitor management frameworks were implemented, isolated monitoring practices were weaved into framework-based monitoring efforts (Bacon et al., 2006). Lessons learned from the long-term monitoring programme of the Great Barrier Reef Marine Park, Australia, also resonate with the Galápagos experience with respect to the incremental maturation of the monitoring programme, utilising participatory monitoring options, and the consideration of innovative methods (Day, 2008).

While incorporating a participatory monitoring approach and technology also occurred in other protected areas such as Yosemite and the Great Barrier Reef, the broad range of stakeholders involved in Galápagos' monitoring is quite unique. Versatile monitoring tools, such as online forms, mobile apps and citizen science initiatives are triggering the participation of even more stakeholders including community residents and tourists. This broad-based participatory monitoring strategy offers an inclusive and flexible platform to generate information that directly benefits management, as compared to more conventional citizen-science models driven by scientists and research questions. On the other hand, participation also helps instill a sense of stewardship as it provides a tangible platform for environmental education, awareness and capacity building. Such participation helps achieve the continuity of the monitoring efforts while emphasising the important role of rangers, tour operators, guides and researchers.

However, significant barriers to implementation need to be overcome by the GNP if the current monitoring partnership is to sustain and achieve further successes. Capacity building, including continual training and support, access to technology, financial and technical support from NGOs, universities, guides and volunteers, are all key elements for sustaining the monitoring process. The question remains: How can we bring all stakeholders to the same table? How can we address all the information needs of the GNP simultaneously? Opening communication channels, like public reporting events, web pages and printed reports to the local community, has been a strategy of the GNP to show transparency and accountability in the monitoring processes and a way to encourage stakeholders' participation and support. We have learned that creating alliances among stakeholders and motivating public engagement in monitoring are critical elements for maintaining support for conservation actions and management of protected areas in the Galápagos Islands. This likely applies to other protected areas too.

In designing a monitoring programme with stakeholders' participation, we have learned that it is important to take an incremental approach with a small number of managerially relevant and simple-to-measure indicators, so that data can be generated efficiently and the utility of monitoring data in management decision making can be communicated. This positive feedback helps demonstrate to the participating stakeholders the value of monitoring and their contribution to it, thereby building trust and motivating them to engage in other monitoring indicators that may require more training. As our example shows, the use of mobile apps helped facilitate monitoring participation and data reporting by tour guides.

As illustrated in this paper, periodic reviews of monitoring programmes and indicators can be valuable exercises as use characteristics, impact issues, technologies and community capacity in support of monitoring may change over time, prompting new monitoring needs and opportunities. In the GNP, the integration of different ecological and social indicator monitoring efforts, developed by researchers and the GNP collaborators, is still a challenge. Another important challenge is to strengthen the connection of science programmes in the Galápagos Islands with the monitoring needs of the GNP so that resources and knowledge could be shared.

The GNP experience of the SIMAVIS framework also reveals that monitoring programmes are useful to management only if they are customised to the local environment, challenges, needs and capacity, even though the adaptive management logic is comparable to well publicised management frameworks in developed countries (McCool et al., 2007; Leung et al., 2018; IVUMC, 2020). Twelve years after SIMAVIS's implementation, the learning process still continues with indicators being conceived and customised for new visitor sites or new tourist use issues. Regional collaborative networks that share similar ecosystem and tourism characteristics can facilitate such learning. For example, the capacity building activities and technical exchange gained under the Eastern Tropical Pacific Marine Corridor initiative (http://cmarpacifico.org/web-cmar/quienes-somos/que-es-el-cmar/), of which the Galápagos Islands is a part, has been valuable in identifying common and replicable approaches for tourism monitoring in areas facing similar challenges.

The 2020 COVID-19 pandemic provided an opportunity to strengthen alliances through the monitoring of critical changes in Galápagos' visitor sites. All Ecuadorian protected areas are experiencing changes due to the sudden partial or complete closures resulting from national lockdowns. In the case of the Galápagos, a coordinated effort among park rangers, researchers and tour guides was quickly put in place to start monitoring of ecological resources and tourist infrastructure such as wildlife and trails at prioritised visitor sites. This speedy response benefitted from the 2017 monitoring protocols that were already in operation. There is a need to evaluate how natural environments and local communities respond to a drastic change in visitation. Results from this special monitoring can be used as a proxy to help understand the baselines of ecosystem indicators without tourist activities and how they may change once tourists return to the islands. The pandemic may therefore have created an ideal natural experiment that will provide crucial information for adaptive tourism management of Galápagos protected areas.

As the world and its protected area system is moving into the post-pandemic era, the Galápagos protected areas must harness this unparalleled opportunity to re-imagine their sustainable future in which the conservation and community development roles of tourism should be strengthened, while its growing burdens on the ecology and local residents should be alleviated. Consequently, tourism use and impact monitoring in the GNP will once again 'evolve' into the next stage with novel indicators and participatory approaches that reflect the new desired futures, evaluating whether the integration of tourism with conservation and community is indeed achievable at the world's first World Heritage Site.

ENDNOTES

1 In the Galápagos context, stakeholders include tour guides, tour operators, NGOs, local communities and academia.

2 The Charles Darwin Foundation is an international NGO created in 1959 to advise the Government of Ecuador on research and conservation measures in the Galápagos Islands.

3 Summarised in the 1975-–1976 WWF Report.

ACKNOWLEDGEMENTS

The authors would like to thank the GNP park staff, Galápagos tour guides and community residents who have participated in the national park's monitoring efforts. Thanks also go to Carolina Carrión Cortez and Zeynab Jouzi for their help with the map, and to the two peer reviewers who offered very valuable comments.

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RESUMEN

El monitoreo oportuno y pertinente del uso y los impactos de las actividades turísticas es cada vez más importante para la gestión adaptativa del turismo en las áreas protegidas. Sin embargo, los programas establecidos inicialmente para el monitoreo deben responder y ajustarse con rapidez a las tendencias y prácticas emergentes relacionadas con las visitas y las consiguientes ramificaciones comunitarias y de conservación. Existen pocos documentos en los que se detallan los éxitos, fracasos y desafíos de programas específicos de monitoreo de las actividades turísticas en las áreas protegidas. En el presente documento se aborda esta brecha recogiendo el desarrollo por etapas del programa de monitoreo sobre el uso e impacto del turismo en el emblemático Parque Nacional Galápagos y compartiendo las principales lecciones extraídas. Desde el decenio de 1960 hasta el presente, hemos identificado cuatro etapas principales de desarrollo del programa de monitoreo impulsado por diversos factores, desde las primeras investigaciones sobre los impactos del turismo en la fauna silvestre hasta el actual programa de monitoreo que supone una importante participación pública y aplicaciones tecnológicas en la implementación de indicadores. Este resumen podría ser de importancia para otras áreas protegidas, especialmente aquellas que están acogiendo un turismo de rápido crecimiento, construyendo programas de monitoreo o contemplando ajustes a sus programas en razón de los nuevos retos en materia de gestión, las necesidades de información o la capacidad para seguir de cerca la implementación.

RÉSUMÉ

Un suivi opportun et pertinent de l'utilisation et des impacts touristiques est de plus en plus important pour la gestion adaptative du tourisme dans les aires protégées. Cependant, les programmes initialement mis en place pour le suivi doivent réagir et s'adapter rapidement aux tendances et schémas émergents en matière de visites et aux ramifications concomitantes de conservation et de communauté. Peu d'articles publiés ont partagé les réussites, les échecs et les défis des programmes spécifiques de surveillance touristique dans les aires protégées. Nous tentons de combler cette lacune en résumant le développement en plusieurs étapes du programme de suivi de l’usage et de l’impact touristique dans le parc national emblématique des Galápagos et en partageant les principales leçons qui peuvent en être tirées. Des années 1960 à nos jours, nous avons identifié quatre étapes majeures dans le développement du programme de suivi, stimulées par une variété de forces, depuis les premières recherches sur les impacts touristiques sur la faune jusqu'au programme actuel qui implique une participation importante du public et des applications technologiques dans la mise en œuvre des indicateurs. Ce résumé devrait être utile à d'autres aires protégées, en particulier celles qui accueillent un tourisme à croissance rapide, et qui élaborent des programmes de suivi ou envisagent d'ajuster leurs programmes en raison de l'évolution des défis de gestion, des besoins d'information ou de la capacité de suivi de leur mise en œuvre.

DELIBERATIVE ASSESSMENT AND MAPPING OF CULTURAL ECOSYSTEM SERVICES PROVISION IN TERRESTRIAL NATIONAL PARKS, KENYA

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ABSTRACT

The ecosystem services concept advocates for incorporation of Cultural Ecosystem Services (CES) into park management. However, challenges abound in the articulation of CES in policy ready measurements. The study aimed to trial a social deliberative GIS method to identify, map, quantify and analyse the distribution of CES in two Kenyan national parks. A sample of park staff was interviewed to identify non-material park benefits in five CES categories. Geospatial analysis was used to quantify and evaluate the benefits spatial distribution. Analysis of spatial associations between the CES found strong to moderate correlation between mapped benefits suggesting co-occurrence of the CES. The analysis revealed CES concentration around hydrological, geological and culturally significant features. These features had the highest benefits intensity and diversity indices while topographic and ecological park attributes diffused associated benefits. Except for two tourism use zones in Tsavo West, no significant difference between intensities of CES benefits was found between other zones in the parks. The study demonstrates the applicability of the deliberative method in assessing protected area CES values. Park managers can rely on the results of such a process to provide legitimate inputs into conservation decisions.

Key words: ecosystem services, cultural ecosystem services, deliberative geographic information system, terrestrial national parks

INTRODUCTION

Cultural Ecosystem Services (CES) are non-material benefits arising from relationships between society and the environment (Millennium Ecosystem Assessment (MEA), 2005). These benefits accrue through recreation and ecotourism, spiritual/religious values, artistic inspiration, heritage, cultural identity, educational values, social relations, knowledge systems, sense of place and landscape aesthetics values (Angarita-Baéz et al., 2017; Casado-Arzuaga et al., 2014; Peña et al., 2015). According to the MEA Report, ecosystems provide other services namely provisioning (e.g., non-timber products), regulating (e.g., carbon sequestration) and supporting services (e.g., pollination) (MEA, 2005).

The International Union for Conservation of Nature (IUCN) describes protected areas as the most effective way to ensure long-term conservation and sustainable provisioning of ecosystem services (Badman & Bomhad, 2008). Protected areas are important for large-scale conservation of species, habitats, cultural heritage, scenic landscapes and threatened biomes that provide opportunities for enjoyment, personal knowledge development and scientific research (Ribeiro & Ribeiro, 2016). Parks are also important for the more introspective benefits such as sense of place and spiritual values (Ribeiro & Ribeiro, 2016).

In the last decade, researchers have advocated for the mainstreaming of the Ecosystem Services (ES) concept into conservation with an eye on sustaining ES provision and their benefits to humanity (Egoh et al., 2012; Gould et al., 2019). This advocacy will continue because of the perceived relevance of the concept in new conservation paradigms. For instance, García-Llorente et al. (2018)

believe that the ES concept promotes a holistic conservation model that integrates social dimensions into hitherto scientific led conservation approaches. They argue that a conservation model hinged on ES can foster support for conservation and avoid park isolation by recognising socio-ecological processes that sustain benefit flows in and out of the parks.

Studies point to increasing recognition of CES as a powerful incentive for biodiversity conservation that provides a complementary view to the scientific perspective of natural resource management (Hernandez-Morcillo et al., 2013; Milcu et al., 2013). Milcu et al. (2013) suggest that conservation stands to gain from a philosophical alignment to the non-utilitarian perspectives inherent in the CES concept. Gould et al. (2019) support this view arguing that the CES concept offers an opportunity to consider both biophysical and social aspects of ecosystems in conservation. However, there is scholarly consensus that the intangibility, intuitiveness and non-market nature of a range of CES benefits, including religious, heritage and educational values, creates difficulties in their quantification and incorporation in conservation (Milcu et al., 2013; Pena et al., 2015). Exclusion of some CES benefits from research generates a fallacy that what is not quantifiable does not matter (Satz et al., 2013), yet society holds positive values for all CES benefits (Brown & Fagerholm, 2015).

Incorporation of the ES framework in biodiversity conservation is still at the embryonic stage and experience with it remains nascent (Ingram et al., 2012). Wangai et al. (2016) demonstrate this gap in a review of fifty-two African studies published between 2005 and 2014. The review reports that 62 per cent of ES research in Africa targeted wetlands and water catchments excluding biodiversity-rich terrestrial ecosystems. Moreover, the studies focused on easily quantifiable and market-ready ES like provisioning, leaving out CES (Wangai et al., 2016). Still, there are elements of resistance to the ES paradigm in conservation circles. García-Llorente et al. (2018) attribute this inertia to drawbacks in the operationalisation of benefits espoused in the concept and unresolved ideological conflicts between ecocentrism and anthropocentrism. There is scope to extend CES research to terrestrial protected areas, the bedrock of conservation, and refine techniques for identification, quantification and assessing a broad range of CES in order to generate research that can produce acceptable and policy-relevant results.

Quantification and mapping of CES are requirements for their inclusion in conservation strategies (Stegarescu & Partidario, 2014). There have been interdisciplinary research efforts to develop robust and acceptable metrics for CES quantification (Bieling & Plieninger, 2013). Egoh et al (2012) appraised ES indicators in sixty

Herd of Burchell's zebra (Equus quagga burchellii) in Tsavo East National Park © Mtana Safaris Limited, Kenya

-seven studies conducted between 1997 and 2011 and found that 48 per cent of the studies focused on quantifying CES. However, consistent with findings from other reviews (e.g., Hernandez-Morcillo et al., 2013), Egoh et al (2012) note that most CES indicators in the studies targeted tourism/recreation and aesthetic enjoyment. From experience in surveys using social and physical CES indicators, research is now moving to the spatialisation of CES. Crossman et al. (2013) note that this research trajectory is informed by the truism that the supply and demand of CES are spatially explicit. Geographical Information Systems (GIS) have contributed to CES mapping by automating capture, storage, analysis and communication of geospatial data. Researchers are experimenting with social assessment methods to elicit qualitative data on CES perceptions and leverage GIS capabilities to quantify and spatialise cultural services. For instance, Ribeiro and Ribeiro (2016) use participatory GIS (PGIS) procedures to map visitors', residents' and park managers' perceptions of CES provision in a Rio De Jeneiro urban park. In a similar study, Canedoli et al. (2017) map variations between citizens' and managers' perceptions of CES provision in a Milan peri-urban park. Both studies analysed the intensity and co-occurrence of CES in the parks. In a recent study, Tew et al. (2019) use data from an online survey and PGIS to generate density maps of CES in a forest plantation in the UK while Johnson et al. (2019) demonstrate the viability of crowd sourced data as input in the spatial analysis of CES in a New York park. In another example, Jones et al. (2019) use a free-listing PGIS exercise to obtain geo-referenced CES data for a Southampton Urban Park and create hotspot maps for ten CES in the park. It is noteworthy that most of the experimentation with social CES assessment methods has been in data-rich developed countries and feature urban recreational parks (Brown & Fagerholm, 2015). Notwithstanding national parks' significance as a source of CES, very limited studies have attempted to assess and map CES in these protected areas.

The study aimed to trial a social CES assessment technique to quantify and map distribution of CES benefits in terrestrial national parks. The research relies on a deliberative GIS protocol to elicit georeferenced data on park managers' perceptions of CES benefits in Tsavo East and West National Parks in Kenya. The research, adopting a case-based approach, contributes to refining techniques for identification, quantification and spatial analysis of CES by offering empirical evidence of the applicability of social assessment GIS mapping methods to assessment at the ecosystem level.

METHODS AND MATERIALS

Study area

Tsavo East National Park (TENP) and Tsavo West National Park (TWNP) measure 13,747 km² and 9,065 km² respectively. The two are part of the Tsavo Conservation Area (Figure 1), Kenya's largest continuous protected ecosystem (Akama & Kieti, 2003; Muteti et al., 2014).

The two parks are made up of a mosaic of habitats; Acacia-Commiphora woodland dominates the northern parts of TENP and TWNP. The woodlands are interspersed with strands of baobab trees (*Adansonia digitata*). Southern TENP is typified by shrubs of the yellow Gul Mohur (*Delonix elata*) and Melia (*Melia volkensii*), while open grassy plains characterise the southern parts of TWNP (Muteti et al., 2014). The parks contain diverse wildlife species notably the African Elephant (*Loxodonta africana*), an array of ungulates and a range of carnivores including Cheetah (*Acinonyx jubatus*), Leopard (*Panthera pardus*) and the African Lion (*Panthera leo*) (Okello et al., 2008). The parks are also important bird areas and host over 400 species including Palaearctic migrants.

Between 2014 and 2018, the two parks accounted for 7 per cent of tourists who visited Kenya's protected areas annually. In this period, an average of 110,153 tourists visited TENP while 52,702 visitors were recorded in TWNP annually (GoK, 2019).

A ten-year plan (2008–2018) guides conservation activities in the parks and prescribes ecological, tourism, community, operations and law enforcement programmes (KWS, 2009). The plan divides the parks into zones reflecting levels of visitor use. There are three user zones in TWNP, namely Kamboyo high use zone

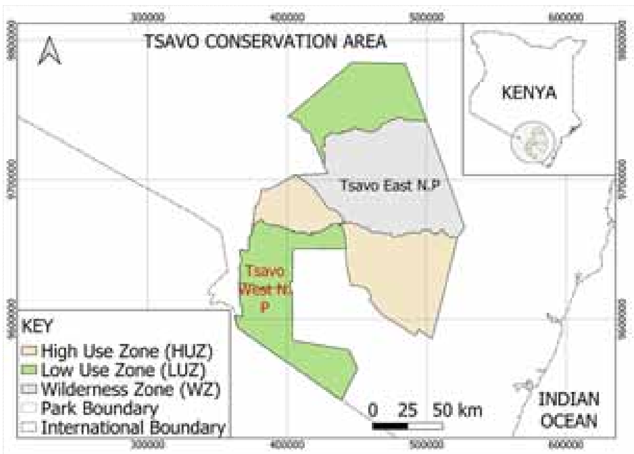

Figure 1. Tsavo West and Tsavo East National Parks

(HUZ), and Murka and Lake Jipe low use zones (LUZ), while in TENP three zones are designated, Voi HUZ, Emusaya wilderness zone (WZ) and Ithumba LUZ.

Data collection

The study collected data from the two parks selected from the country's network of national parks due to their importance for visitation and ecological relatedness (Cheung, 2012; Said et al., 2007). The study collected data on five CES benefit categories (Table 1) – ecotourism & recreation, landscape aesthetics, knowledge development & scientific research, religious & spiritual, historical & heritage between July and November 2019. Thirty indicators were used to operationalise the CES benefits.

Following Palomo et al. (2013), the study relied on deliberative mapping, a social assessment technique to elicit social values of wildlife protected areas from managers directly involved in operational activities in the parks. The study targeted three key informants from seven operational departments of the parks including administration, research, veterinary, security, community wildlife service, tourism and education. Twenty-one (n = 21) members of staff were purposively selected to participate in the survey. The study assumes that the respondents are sufficiently knowledgeable about their respective parks and could provide accurate data on CES benefits (see Brown et al., 2004; Klain & Chan, 2012; Palomo et al., 2013; Raymond et al., 2009). The study acknowledges that other stakeholders (e.g., tour operators and lodge managers) operating in the park could complement data obtained from park officials. However, the researchers excluded these stakeholder categories from the study as its focus was on trialing the deliberative CES mapping protocol in parks (see Klain & Chan, 2012).

Willcock et al. (2017) recommend site based supervised interviews for collecting data on intuitive constructs. Following this recommendation, social assessment and GIS techniques were adopted from similar studies to identify and map park CES benefits (e.g., Fagerholm & Käyhkö, 2009; Tew et al., 2019). The deliberative GIS

Table 1. Descriptions of CES benefits and indicators adopted in mapping CES benefits in the National Parks (Source: Adapted from Jones et al., 2019; Plieninger et al., 2013)

Cultural Ecosystem Services	Description	Indicators
Ecotourism and recreation	Park user well-being from participation in recreational and ecotourism activities in the park.	• Opportunities for recreation activities (campsite; sport fishing; bird watching; wildlife viewing/photography; walking; biking; boating; cave exploration and rock climbing). • Opportunities for ecotourism (mineral licks; watering pans; viewing hides; migratory routes; breeding grounds; known wildlife ranges/habitat; grazing areas; and species sanctuary).
Landscape aesthetic	User benefits from appreciation of park landscapes and features of notable aesthetic beauty.	• Opportunities for appreciation of features of natural beauty. • Opportunities for appreciation of landscapes of notable aesthetic appeal.
Knowledge development and scientific research	User benefits resulting from development of individuals' personal knowledge and research.	• Opportunities for scientific study (riverine forest; iconic species range; roosting grounds; wilderness area). • Opportunities for education (nature trail; bird walk; educational/visitor information centre).
Spiritual and religious benefits	User benefits resulting from visit to sites/feature of spiritual/religious and other forms of worship in the park.	• Shrines of spiritual importance (e.g. cave, hills, mountain, groves). • Opportunities for closeness to nature (e.g. picnic sites).
History and heritage benefits	User welfare from visit to sites/feature of particular relevance to human history and way of life.	• Historical/heritage sites. • Cultural features (e.g. hills).

mapping procedure employed individualised data collection due to the eclectic nature of the data sought. This approach allowed interviewers to supervise and interact with the respondents during the mapping process. The respondents completed a questionnaire that elicited data on their (i) knowledge and experience of the park, (ii) perceptions on the park's suitability for providing opportunities to experience CES benefits and (iii) basic demographics (see, Jones et al., 2019; Plieninger et al., 2013). On average, each respondent took 20 minutes to complete the questionnaire.

The mapping exercise commenced by orienting respondents to their respective park topographic maps. A1 Maps were used for TWNP (1:500,000) and TENP (1:650,000). The process required respondents to identify CES benefits using a list of indicators (Table 1) and map benefit sites by drawing polygons, lines and point geometries on the map to show areas, routes and point features respectively. Respondents used colour coded pencils and letter codes to distinguish different CES benefits drawn and could identify multiple sites for each benefit. On average, each interviewee spent 45 minutes mapping the benefits working separately but under the supervision of an interviewer.

Data analysis

The study summarised the respondents' demographic attributes and the frequency of sites identified using descriptive statistics. Subsequently, the analysis compared pairs of respondents' ratings of the parks' suitability to provide CES using Pearson's product moment correlation.

To prepare a geospatial database, maps on which respondents had marked CES benefit indicators were scanned and georeferenced in Arc1960 (EPSG: 4210) geographic coordinate reference system (CRS). Marked point features, routes and areas were digitised into point, line and polygon shapefiles respectively and re-projected to UTM Zone 37S (EPSG: 21037) for further geospatial analysis (Sutton et al., 2009). To simplify the geometries, the analysis computed polygon centroids and mean coordinates for line CES benefit layers. These were merged with point layers to produce CES benefits shapefiles.

Heatmaps of CES benefits were created using Kernel density estimation (KDE) from the aggregated benefits shapefiles. The resultant raster surfaces displayed CES benefits concentration classified using Jenks natural breaks (see Brown & Fagerholm, 2015; Jones et al., 2019; Tew et al., 2018). To quantity benefits distribution, the analysis calculated spatial intensity and diversity indices from counts of CES benefits in 25 km^2 grid cells (see Fagerholm et al., 2012; Plieninger et al., 2013). The cell size was ideal for capturing CES variations in rapidly changing physiographical conditions. Spatial intensity considered counts per unit area while the Shannon index (H*) was computed to study the diversity of aggregated CES benefit counts (See Angarita-Baez et al., 2017; Fagerholm et al., 2012).

Subsequently, the study carried out Pearson's correlation analysis on counts of benefit categories in randomly sampled sites within the parks to examine spatial associations in the CES categories (Casado-Arzuaga et al., 2014). Magnitudes of estimated Pearson's correlation coefficients were interpreted as the co-occurrence between CES categories where ($r \geq .50$) indicated strong, ($r \geq .30$) showed moderate and ($r \leq .50$) indicated weak associations (Adams & Lawrence, 2015; Fagerholm et al., 2012). Finally, the study used one-way ANOVA to uncover spatial differences in benefits occurrences between park zones designated by level of tourism use. The research used QGIS 3.8 to carry out geospatial analysis, SPSS and Ms Excel for statistical analysis.

RESULTS

Respondents' demographic and psychographic profile

Twenty-one respondents representing 214 staff from operational departments in the parks (KWS, 2009) participated in the study. Of the respondents, 76.2 per cent were male, while 23.8 per cent were female. Interviewees above 45 years accounted for 38 per cent of the sample while 5 per cent were below 30 years. The respondents were well educated; 85.7 per cent of them had attained college diplomas while 29 per cent had post -graduate degrees. Most respondents were experienced, 61.9 per cent had worked in the parks for more than 15 years. This result corroborates their self-rating of park knowledge, which ranged from 4 to 5 on a 1–5 scale. On average, the respondents were moderately knowledgeable about their park's unique values (mean = 4.14, SD = 0.36).

The results of Pearson correlation analysis of pairs of respondents' ratings of respective parks' suitability for visitor experiences indicate a significant strong association between indicators of knowledge development and scientific research ($r = .55$; $p \leq .01$) and a moderately strong association between cultural significant species and tourism activities including wildlife viewing/photography ($r = .48$; $p \leq .05$). The results show a moderately strong association between closeness to nature and opportunities for knowledge development ($r = .37$; $p \leq .05$). As shown in Table 2, there were no significant associations between other benefits indicator pairs.

CES benefits identified in the parks

Consistent with previous research findings, the results indicate that opportunities for ecotourism and recreation were the most frequently identified benefits and accounted for 63 per cent of the identified 944 features, routes and areas conferring CES benefits in the two parks. Knowledge development and scientific research opportunities accounted for 18 per cent, opportunities for landscape aesthetic appreciation 13 per cent, sites for history & heritage appreciation 5 per cent, and spiritual & religious benefits accounted for less than 1 per cent. In TENP, locations for ecotourism & recreation experiences like campsites, wildlife watering pans, bird-watching and wildlife photography sites were the most commonly identified by count and number of respondents. On the other hand, breeding areas, walking routes, roosting grounds and bird walks associated with knowledge development and scientific research opportunities were the least common. In TWNP, respondents frequently cited ecotourism and recreation opportunities at watering pans, campsites and ideal sites for wildlife photography and commonly identified landscape scenic features and areas of notable aesthetic appeal.

Concentration of CES benefits in the parks

The results in Figure 2 show that CES benefits in TENP clustered in seven locations of very high and high concentration labelled A–G: opportunities for wildlife viewing and photography were located along the Galana River at Sobo and Lugard's Falls, Voi River in the Ndololo-Kanderi circuit, pipeline area, and at Aruba Dam. However, ecotourism and recreation benefits occurred widely in the Voi area because of numerous waterholes, saltlicks, grazing areas and migratory routes. The results indicate that Lugard's Falls on Galana River and Mudanda Rock were important for landscape aesthetic appreciation, spiritual & religious benefits, experiences of closeness with nature and heritage appreciation. A focal point for knowledge development benefits was at the Voi gate education/ visitor information centre. On the other hand, diffusion of scientific research opportunities in the southern sector was due to research potential in species ranges and riverine forests found in the area. The results reveal moderate concentration of opportunities for scientific research in the wilderness habitats characterising the northern sector of TENP.

Results presented in Figure 3 show that opportunities for appreciation of various CES benefits were ubiquitous in TWNP albeit to varying degrees. Notable locations with very high concentration of tourism benefits in the park were at Ngulia Rhino sanctuary, a Black Rhino intensive protection zone (IPZ) ideal for wildlife viewing, Kamboyo, Mzima Springs and Lake Jipe. The results show landscape appreciation benefits concentration at Mzima Springs, Kichwa Tembo and Shetani Lava Flows corresponding to notable natural features. On the other hand, Lake Jipe, rhino valley and

Table 2. Pearson correlation coefficients (r) of parks' suitability to provide Cultural Ecosystem Services ratings (*$P \le .05$; **$P \le .01$)

CES Benefits	1	2	3	4	5	6	7	8	9	10
1. Ecotourism	1									
2. Recreation	-.200	1								
3. Scenic appreciation	.032	.241	1							
4. Scientific research	.210	.201	.061	1						
5. Knowledge development	.202	.358	.338	.545**	1					
6. Spiritual/religious	-.073	-.018	.174	-.089	.280	1				
7. Closeness to nature	.045	.165	.032	.374*	-.005	-.073	1			
8. Human history	.186	.000	.243	.000	.101	.197	-.279	1		
9. Cultural species	.475*	-.030	-.072	.265	.090	-.140	.330	.282	1	
10. Cultural features	.151	.246	-.263	-.147	-.323	-.243	-.061	.069	-.076	1

Ngulia Hills diffuse opportunities for landscape aesthetics appreciation over a wide area. A concentration of CES benefits in Kamboyo area is due to opportunities for knowledge development and scientific research at the visitor education centre and it is a known wildlife habitat. Also identified was a focal point for spiritual & religious benefits around Shetani Lava Flows, while heritage & historical benefits were prominent at the Rhodesia War bridge on Tsavo River and at the Man-eaters cave, accounting for the moderate CES benefits concentrations in these areas.

Heatmaps were useful in showing the concentration of CES within parks (e.g., Jones et al., 2019; Tew et al., 2019). However, they could not generate quantitative measures of the distributions. The study computed alternative quantitative indices to study the aggregated distribution of CES benefits in the parks.

Intensity and diversity of CES benefits

The benefits intensity and diversity indices show that in TENP, Mudanda Rock, a 1.6 km inselberg ideal for wildlife viewing and heritage appreciation had the highest intensity of CES benefits (I = 0.44–0.78/km2) while Lugard's Falls and Sobo Rock on the Galana River were second with intensities between 0.24–0.44km2. These three sites had the highest diversity of benefits (H* = 0.48–0.58). Other notable locations with a high

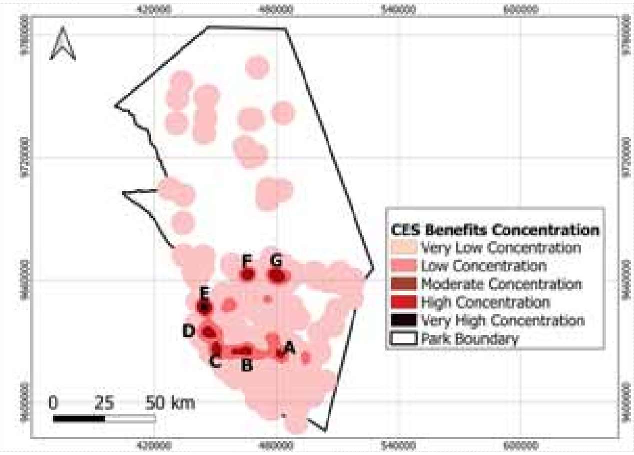

Figure 2. Concentration of Cultural Ecosystem Services in Tsavo East National Park.
*KEY: A = Aruba Dam; B = Kanderi-Ndololo; C = Voi Gate; D = Pipeline; E = Mudanda Rock, F=Lugard's Falls; G = Sobo Rock.

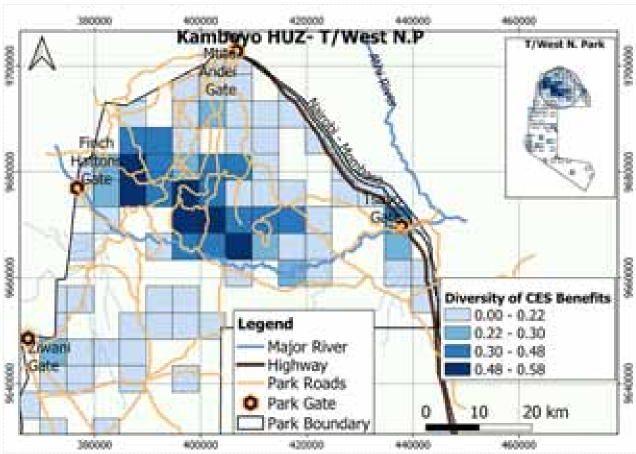

Figure 4. Diversity of Cultural Ecosystem Services Benefits in Tsavo West National Park.

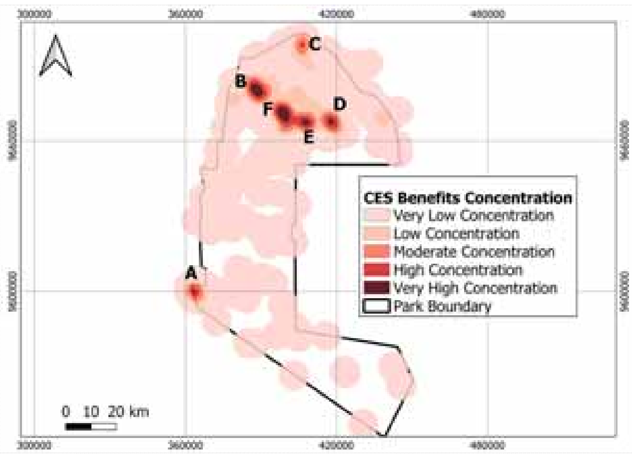

Figure 3. Concentration of Cultural Ecosystem Services benefits in Tsavo West National Park
*Key: A = Lake Jipe; B = Shetani Lava; C = Kamboyo; D = Ngulia Rhino Sanctuary; E = Kichwa Tembo, F= Mzima Springs

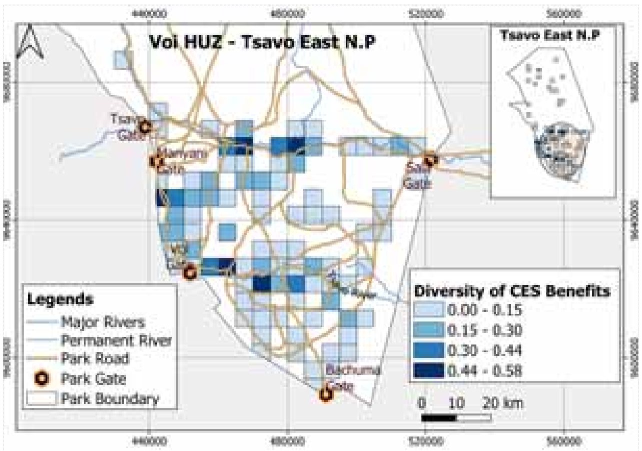

Figure Diversity of Cultural Ecosystem Services in Tsavo East National Park.

diversity of CES benefits were in the riparian vegetation along Voi River and the *Kanderi—Ndololo* wildlife viewing circuit. In TWNP, the results show that Ngulia sanctuary, Mzima springs, rhino valley and Lake Jipe had the highest CES benefits intensity (I = 0.44–0.72/ km²) and diversity (H^*= 0.48–0.58). Figures 4 and 5 show the diversity of CES distribution in TWNP and TENP respectively.

Results of Pearson's correlation analysis of CES benefits in randomly selected locations shows that in TWNP, opportunities for landscape aesthetic appreciation strongly correlate with sites for religious & spiritual benefits and with sites for recreation & ecotourism. The findings reveal a moderate positive association between religious & spiritual benefits and ecotourism & recreation opportunities and between landscape aesthetic appreciation and opportunities for knowledge development and scientific research in TWNP. In TENP, the results suggest a strong correlation between landscape aesthetics appreciation and history & heritage appreciation benefits opportunities as well as between opportunities for landscape aesthetics appreciation and places for spiritual & religious benefits. Evidence was found of strong correlation between sites for spiritual & religious benefits and historical & heritage sites in the park.

African Elephant (*Loxodonta africana*) in Tsavo West National Park © www.mtanasafaris.com

The study compared means of the intensities of CES benefits in the parks' tourism use zones. A one-way between samples analysis of variance (ANOVA) was conducted to compare means of the intensity of CES benefits from sites in Mzima HUZ (n = 71), Murka LUZ (n = 43) and Lake Jipe LUZ (n = 29) in TWNP. The results of the Welch test show that there was a significant difference between the intensities of CES benefits in the three zones; Mzima HUZ (mean = 0.16, SD = 0.16), Murka LUZ (mean = 0.09, SD = 0.11) and Lake Jipe LUZ (mean = 0.10, SD = 0.115). However, the Scheffe post-hoc analysis revealed a significant difference between CES benefits intensities in Mzima HUZ and Murka LUZ (p = 0.03), no statistically significant difference in CES benefit intensities between Mzima HUZ and Lake Jipe LUZ (p = 0.10) and between Murka and Lake Jipe LUZ (p = 0.10). In TENP, the ANOVA test returned no significant difference between the means of intensities of CES benefits in Voi HUZ (n = 89; mean = 0.13, SD = 0.13), Emusaya (WZ) (n = 29; mean = 0.10, SD = 0.121) and Ithumba HUZ (n = 8; mean = 0.05, SD = 0.02); ($F(2,123) = 1.8$, p = 0.14).

DISCUSSION

CES in the Tsavo Conservation Area

The study aimed to trial a deliberative GIS mapping technique for capturing stakeholders' perceptions of CES benefits, identifying and analysing the benefits' spatial distribution. The research focused on CES associated with park visitation excluding ex-situ intrinsic benefits such as artistic inspiration, sense of place and cultural identity. The results demonstrate in a case-based study the utility of social methods in assessing subjective non-material benefits in national parks.

The results of the respondents' rating of the parks' suitability to provide CES suggest that they were able to distinguish CES by their benefits, demonstrating the viability of a consideration of the social dimensions of ecosystems in park management plans as recommended in the literature (e.g., Garcia-Llorente et al., 2018). However, as in other jurisdictions, park management plans in the study areas do not explicitly consider the range of CES benefits.

The results affirm previous research findings in urban parks that ecotourism and recreation were readily recognised and the most frequently cited CES benefits (Canedoli et al., 2017; Muller et al., 2019; Raymond et al., 2009; Ribeiro & Ribeiro, 2016; Tew *et al.*, 2019). On the other hand, fewer respondents recognised and mapped the more introspective benefits like heritage and religious benefits. The results support the view that park managers less readily appreciate the latter CES benefits. Consequently, they may underplay their importance to other park users.

Spatial distribution of CES

The spatial distribution of CES benefits in the two parks confirm the axiom that ES are not scattered randomly but occur in patterns that coincide with natural features, socially significant sites, hydrological features and ecological habitats (Fagerholm et al., 2012; Plieninger et al., 2013; Muller et al., 2019; Ribeiro & Ribeiro, 2016). In TWNP, prime areas for scenic appreciation correspond to geological features like Shetani Lava Flows, a 40-km2 expanse of solidified lava formed some 500 years ago; Mzima Springs which are fountains of crystal-clear waters teeming with aquatic fauna, and Kichwa Tembo. In TENP, focal points for ecotourism and recreation were around water features viz., Galana River, Voi River and Aruba Dam that attract large concentrations of wildlife species.

On the other hand, low CES endowments correspond to areas characterised by vegetation types not suitable for visitor activities including habitats dominated by dense Commiphora spp, Delonix spp and Melia sp in the northern sector of TENP (Ngene et al., 2011). In TWNP, low CES benefits density corresponds to habitats with low wildlife populations, sparse fodder, limited cover and water scarcity in the drylands of Murka LUZ. Ngene et al. (2011) report a high concentration of dry water pans and high incidences of livestock incursions in this area.

Examination of the CES benefits intensity and diversity indices confirmed clusters and co-occurrence of particular combinations of benefits. In TWNP, correlation results show co-occurrence of ecotourism & recreation, knowledge development & scientific research, landscape aesthetics, and religious & spiritual opportunities. These results are similar to the findings by Ribeiro and Ribeiro (2016) who observed very weak associations between cultural heritage and ecotourism & recreation, religious & spiritual benefits and knowledge development in an urban national park. In TENP, the results imply strong associations between scenic appreciation, spiritual, and heritage appreciation benefits that have a higher emotional dimension compared to ecotourism & recreation and knowledge development & scientific research that occur together. This observation suggests a distinction between abstract and relatively tangible CES as suggested by Ament et al. (2017).

Co-occurrence of benefits is attributable to indirect relationships between the benefits derived from underlying biophysical and social factors as suggested by Vallet et al. (2018). The results of this study support the notion that biodiversity and habitats like riparian vegetation, migratory routes, breeding grounds, grazing areas and species sanctuaries provide opportunities for ecotourism and serve as areas for scientific research. At the same time, natural features like rivers, hills, inselbergs and viewpoints are sites for recreation activities, spiritual reflection, and are vantage points for scenic appreciation. Because of their relevance to the host communities, such features are associated with historical/heritage and spiritual/religious benefits.

CES benefits and visitor use zones

The results show no difference between visitor use zones in TENP according to their CES benefit endowment. However, in TWNP, differences in the user zones are attributable to dissimilarities in one paired comparison out of the three possible comparisons. These findings confirm that the visitor zonation scheme used in the parks does not reflect user benefits derived from ecosystem services. The Protected Area Planning Framework (PAPF) used to guide conservation planning in the parks adopts a zonation scheme based on current visitor use patterns and ecological sensitivity to zone the parks (KWS, 2007).

CONCLUSION

Because of the study's design, it did not assess CES perspectives from all park stakeholder categories. However, the study demonstrates the practicability of the CES framework and the utility of deliberative GIS techniques in capturing diverse subjective values of protected areas in a manner that is amenable for use in conservation decisions. Experience from the case study should motivate future research to incorporate diverse stakeholders' perceptions of non-material values arising from their interactions with and local knowledge of the environment using the CES framework. At the same time, park managers have an opportunity to leverage social ES assessment techniques like the more inclusive PGIS to promote wider stakeholder engagement in protected area management, benefit from the social capital created in the inclusive process and create broader acceptability of conservation programmes.

The study confirmed that CES in protected areas were not scattered randomly but occur in high and low concentration areas that coincide with topographic, hydrological, socially significant features, and ecological habitats. The spatial variability of CES can support an alternative park zonation framework based on assessed park values instead of the often-used inorganic zonation schemes that rely on administrative regions and tourism use levels. Such a zonation can support prescription of targeted park management initiatives based on explicit social values to augment conservation programmes informed purely by biophysical ecosystem condition indicators (e.g., ecological sensitivity).

The research found strong associations between CES benefit categories occurring jointly in particular locations. Park managers can exploit synergies that exist in the supply of recreation and tourism, personal knowledge development and scientific research, and scenic/aesthetic appreciation benefits to develop and package tourism experiences that offer diverse experiences and appeal to different market segments. Although the study's findings allude to an association between ecosystem characteristics and CES provision, the study did not establish specific one-on-one correspondences between CES and park features. There is scope for future research to clarify the links between ecosystem characteristics such as topographic or ecological features and CES supply. The outcomes of such an investigation can better inform park managers about the effects of marginal changes in ecosystem characteristics on their capacity to provide CES.

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RESUMEN

El concepto de servicios de los ecosistemas aboga por la incorporación de los servicios culturales de los ecosistemas (SCE) en la gestión de los parques. Sin embargo, abundan los obstáculos inherentes a la articulación de los SCE en las políticas. El estudio tenía por objeto poner a prueba un método SIG de deliberación social para identificar, mapear, cuantificar y analizar la distribución de los SCE en dos parques nacionales de Kenia. Se entrevistó a una muestra del personal del parque para identificar los beneficios no materiales del parque en cinco categorías de SCE. Se utilizó el análisis geoespacial para cuantificar y evaluar la distribución espacial de los beneficios. El análisis de las asociaciones espaciales entre los SCE halló una correlación de fuerte a moderada entre los beneficios mapeados que sugiere la coocurrencia de los SCE. El análisis reveló una concentración de SCE en torno a características hidrológicas, geológicas y culturales significativas. Estas características tenían los mayores índices de intensidad y diversidad de beneficios, en tanto que los atributos topográficos y ecológicos del parque dispersaban los beneficios asociados. Con excepción de dos zonas de uso turístico en Tsavo West, no se encontró diferencias significativas entre las intensidades de los beneficios de los SCE entre otras zonas de los parques. El estudio demuestra la aplicabilidad del método deliberativo en la evaluación de los valores de los SCE en las áreas protegidas. Los administradores de los parques pueden confiar en los resultados de dicho proceso para proporcionar aportes legítimos a las decisiones de conservación.

RÉSUMÉ

Le concept de services écosystémiques préconise l'incorporation des Services écosystémiques culturels (CES) dans la gestion des parcs. Toutefois, les défis abondent dans l'articulation des CES dans les mesures stratégiques. Notre étude visait à tester une méthode de SIG délibérative sociale pour identifier, cartographier, quantifier et analyser la distribution des CES dans deux parcs nationaux kenyans. Un échantillon de personnel a été interviewé afin d'identifier les avantages non-matériels de cinq catégories de CES. L'analyse géospatiale a été utilisée pour quantifier et évaluer la distribution spatiale des avantages. L'analyse des associations spatiales entre les CES a révélé une corrélation forte à modérée entre les avantages cartographiés, suggérant la cooccurrence des CES. L'analyse a révélé une concentration des CES autour des éléments hydrologiques, géologiques et culturellement significatifs des parcs. Ces éléments présentaient les indices d'intensité et de diversité d'avantages les plus élevés, tandis que les attributs topographiques et écologiques des parcs présentaient des avantages associés. A l'exception de deux zones d'utilisation touristique à Tsavo Ouest, aucune différence significative n'a été constatée entre les intensités des avantages des CES dans les autres zones des parcs. L'étude démontre l'applicabilité de la méthode délibérative à l'évaluation des valeurs CES dans les aires protégées. Les gestionnaires des parcs peuvent compter sur les résultats d'un tel processus pour fournir des contributions légitimes aux décisions de conservation.

HOW EFFECTIVE ARE TIGER CONSERVATION AREAS AT MANAGING THEIR SITES AGAINST THE CONSERVATION ASSURED | TIGER STANDARDS (CA|TS)?

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ABSTRACT

A global pledge to double wild Tiger populations by 2022 has focused attention on the need for effective conservation management. Conservation Assured | Tiger Standards (CA|TS) was established to identify good management standards for Tigers and promote these within Tiger conservation areas (TCAs). The study reported here assessed TCA management against a simplified version of CA|TS to uncover potential shortfalls in management and provide recommendations for future practices. From 11 Tiger range countries (TRCs), 111 TCAs were surveyed on their implementation of 40 strategic Tiger management activities, making it the largest Tiger management study to date. The study found that over a third of TCAs have major management deficiencies, threatening the survival of wild Tigers, biodiversity and natural resources. These deficiencies are especially prominent in South East Asian countries compared to other TRCs. Non-South East Asian countries had a significantly higher percentage of TCAs that had fully implemented the activities outlined in the survey. The lowest scoring elements of management, excluding tourism since that did not apply to all TCAs, were infrastructure, equipment and facilities, protection, and community relations. Recommendations include increased government funding, capacity building, and the implementation of CA|TS to secure the future of wild Tigers.

Key words: *Panthera tigris*, Tiger, management effectiveness, protection, survey, Conservation Assured | Tiger Standards, CA|TS

INTRODUCTION

The global population of wild Tigers (*Panthera tigris*) has fallen by over 95 per cent since the beginning of the 20th century (Wolf & Ripple, 2017) and Tigers have lost over 93 per cent of their historic range (Wikramanayake et al., 2011; Walston et al., 2010). Much of this decline is recent with Tigers occupying about half the range they did just ten years ago. Tigers are no longer found in the Bali, Caspian and Javan regions and there have been no reliable sightings for the last 25 years in South China. Both Tiger sub-species (Wilting et al., 2015), the continental Tiger (*Panthers tigris tigris*) present across the mainland and the Sunda Tiger (P*anthera tigris sondiaca*) occurring across the island of Indonesia, are endangered and there is no evidence of breeding populations of Tigers in Cambodia, Vietnam, and Lao PDR (Goodrich et al., 2015; Harihar et al., 2018; Knoka et al., 2018). Both the sub-species present across South East Asia are facing severe threat from illegal hunting and snaring, the single biggest cause of decline (Belecky & Gray, 2020). But South East Asia also holds the opportunity to the future Tiger recovery. Effective management and investment in areas where the population is still present, and possibilities of rewilding or reintroduction and breeding, with the availability of vast interconnect habitat provides the future hope for the Tigers in the region.

The Tiger's demise led to a global pledge to double wild Tiger populations by 2022, which was made at the St Petersburg International Tiger Forum ('Tiger Summit') in 2010, providing important political backing for conservation efforts in Tiger landscapes (GTI, 2010). There are some indications that this increased attention is beginning to improve the survival of Tiger populations in the wild (Jhala et al., 2019). However, progress remains inconsistent across the range (Knoka et al., 2018), particularly where recovery of prey species is also required (Harihar et al., 2018).

Some governments of Tiger range countries (TRCs) are failing to invest sufficiently in Tiger conservation, and the dramatic decline of Tigers across South East Asia in particular (Goodrich et al., 2015) is a clear indication that many protected areas in this region are failing to reach the minimum standards for effective management found in other countries with greater success in securing wild Tigers (Jhala et al., 2019). Thus, there is a need to prescribe the protection and management standards needed to secure wild Tigers across the range, and then systematically to assess management effectiveness, to record successes and identify areas of management weakness where actions are needed (Harihar et al., 2018; Pasha et al., 2018).

In response, Conservation Assured | Tiger Standards (CA|TS) was established to identify good management standards for Tigers and promote these within Tiger conservation areas (TCAs) (Pasha et al., 2018). A TCA is defined here as a tract of land that has been recognised as Tiger habitat; it may be a protected area (e.g. nature reserve, park, wildlife sanctuary, community conserved area), land reclamation project, forest unit, or other area recognised for its ability to support Tiger populations or with the potential to do so (Conservation Assured, 2020). CA|TS is an accreditation system in which participating TCAs need to provide evidence demonstrating that they meet a range of criteria relating to management effectiveness (Conservation Assured, 2020). The management standards, drawn up by specialists from around the world, are central to maintaining and building Tiger populations (Pasha et al., 2018). CA|TS has a management structure that includes both global and national committees and an active CA|TS Support Group made up of international NGOs, institutions, intergovernmental organisations, non-Tiger range governments and donor organisations whose role is to support, promote and implement CA|TS and to work closely with government agencies responsible for Tiger conservation. CA|TS differs from other management effectiveness evaluation tools, such as the Management Effective Evaluation for Tiger Reserves (MEETR) (Mathur et al., 2014) in two ways: 1) it identifies management issues and sets out methods for improvement, and 2) provides a range-wide standard for comparison, whereas most other management effectiveness systems set local standards designed for specific regions (Pasha et al., 2018).

In order to understand the level of management actions required across the Tiger range, the CA|TS Support Group carried out a survey of over 100 TCAs using a questionnaire approach based on the full CA|TS

Tiger on the prowl © MKS Pasha

standards and criteria (Conservation Assured, 2020). The aims were:

- to provide an overview of how well TCAs measure against CA|TS;
- to understand broad regional differences in Tiger conservation; and
- to understand the general level of management effectiveness in terms of Tiger conservation and better understand the challenges faced in protecting wild Tigers.

The findings from the study will be used to set priorities for effective management, conservation investment and capacity building.

METHODS

CA|TS is organised around seven 'pillars' and 17 'elements' of management (Table 1), with elements containing a range of management standards that are expressed through detailed criteria and elucidated by guidance notes and best practices (Conservation Assured, 2020). The management standards and criteria under each element focus on issues related to Tiger conservation. The system was designed to have applicability across all TRCs, covering varied geographical, cultural and ecological needs (Pasha et al., 2018).

The survey included 40 questions based on a simplified version of the standards (see Supplementary Online Material), with each question associated with a certain pillar and element from Table 1. For each question, five options were given for the responses: 1 = recognised and action implemented; 0.75 = recognised and action initiated; 0.5 = recognised and action being planned; 0.25 = recognised but no action initiated; 0 = not recognised.

A sample survey was conducted initially in five TCAs from India, Nepal and Russia to resolve any potential methodological and implementation issues, and to ensure that the questionnaire was comprehensible and interpreted correctly.

The Global Tiger Forum, assisted by members of the CA|TS Support Group, approached 180 TCAs in all extant TRCs, plus one site in Cambodia where there is ongoing work to prepare for Tiger reintroduction. The survey was completed by field experts and site managers or their staff. The survey thus represents the opinions of

Table 1. Pillars and elements of the Conservation Assured | Tiger Standards

Pillars	Elements
A: Importance and status	1. Social, cultural and biological significance 2. Area design 3. Legal status, regulation and compliance
B: Management	4. Management planning 5. Management plan/system implementation 6. Management processes 7. Staffing (full-time and part-time) 8. Infrastructure, equipment and facilities 9. Sustainability of financial resources 10. Adaptive management (feedback loop)
C: Community	11. Human–wildlife conflict (HWC) 12. Community relations 13. Stakeholder relationships
D: Tourism (optional)	14. Tourism and interpretation (*Note: this standard is only applicable to TCAs with major tourism operations*)
E: Protection	15. Protection
F: Habitat management	16. Habitat and prey management
G: Tiger populations	17. Tiger populations

those most directly involved in site-based management about management effectiveness, gaps and needs.

The initial analysis of the findings was then made on the sum of the scores assigned to each question in the survey. Additional statistical analysis was carried out on the pillars and elements mentioned in Table 1, with the scores for these grouped into each of the seven pillars and 17 elements. Broad regional comparisons were also made, since the initial analysis of the findings revealed clear differences between the management effectiveness of South East Asian and other TCAs. Two broad categories of sites, South East Asia (20 sites from Cambodia, Indonesia, Malaysia, Myanmar and Thailand) and non-South East Asia (91 sites from Bangladesh, Bhutan, China, India, Nepal and Russia) were used for further analysis. Fisher's exact test (nonparametric version of the Chi square test) was used to compare the percentage of surveyed Tiger sites from South East Asia (n = 20) and non-South East Asian countries (n = 91) by grouping the scores into two categories of ≥ 0.5 and ≤ 0.5 to observe any broad regional trends between the lower and upper halves of the scores, which indicate different levels of action initiation and implementation.

RESULTS

Survey responses were received from 111 TCAs from 11 TRCs (Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Nepal, Russia and Thailand; Figure 1); 62 per cent of those approached. By area the survey covered approximately 28 per cent of the

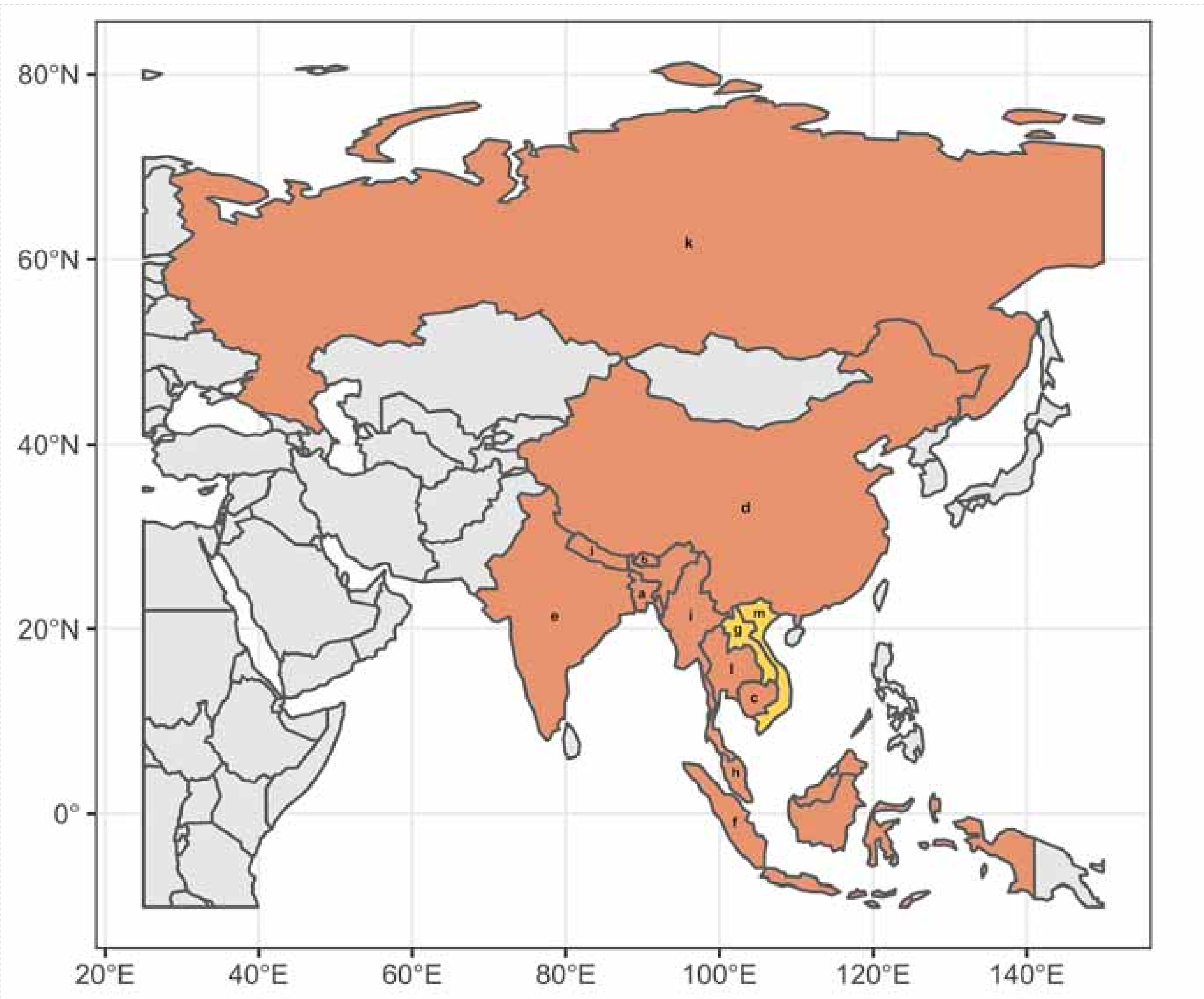

Figure 1. Tiger Range Countries (TRCs) (orange and yellow). The countries that responded to the survey are in orange (11 of the 13 TRCs). The numbers on the map refer to all TRCs which are given in alphabetical order: Bangladesh (1), Bhutan (2), Cambodia (3), China (4), India (5), Indonesia (6), Laos (7), Malaysia (8), Myanmar (9), Nepal (10), Russia (11), Thailand (12) and Vietnam (13)

total 700,000 km² Tiger range (Goodrich et al., 2015), however as Tigers are concentrated in only a small part of this range (200,000 km², Goodrich et al., 2015) the survey represented approximately 70 per cent of global wild Tiger populations. Responses were received from all Tiger range countries except Lao PDR and Vietnam. The majority of the responses were from India (72 sites), followed by Indonesia (9 sites), Bhutan (6 sites), Nepal (5 sites), Russia and Myanmar (4 sites each), Thailand, Malaysia and China (3 sites each), and Bangladesh and Cambodia (one site each); a regional spread that reflects the range-wide distribution and relative abundances of wild Tigers across the TRCs.

The Fisher's test revealed that there was a statistically significant difference ($P < 0.0001$) between the overall scores of South East Asia ($n = 20$) and the other countries surveyed ($n = 91$). South East Asia's scores were divided evenly, with 10 TCAs having scores greater than or equal to 0.5 (actions initiated or implemented) and 10 TCAs with scores lower than or equal to 0.5 (indicating the lack of implementation), resulting in 50 per cent for both. While non-South East Asian countries showed a major difference between these two categories, with 89 TCAs (98 per cent) having scores greater than 0.5, and only two TCAs (2 per cent) having scores lower than 0.5.

Figure 2 provides an overview of the implemented and initiated actions for the TCAs based on the seven CA|TS pillars, and compares South East Asia with other sites, and the overall scores. It suggests that enforcement against poaching (Pillar E), habitat management (Pillar F) and management of community issues (Pillar C) are the weakest management categories across the TRCs (excluding tourism management (Pillar D), since tourism is not suitable or actively pursued in all TCAs). Overall, management is remarkably weaker across South East Asia.

Further insight was provided by separating the results into the 17 elements of CA|TS. Figure 3 shows a more detailed version of the percentage of TCAs that have either implemented or initiated the actions for the seventeen elements and compares the differences in scores for South East Asia, other TRCs and the overall scores more directly. Overall, it was found that the sites surveyed are strongest on management planning and processes, middling on prey management and protection, and weakest on the social issues related to management.

Figure 4 identifies the TCAs that have fully implemented the actions outlined from the 40 survey questions (the questions are summarised here; see Supplementary Online Material for the full questionnaire). This shows that although many TCAs have the basics of good conservation management in place, the lowest scoring questions (i.e. the management actions that the lowest number of TCAs have implemented) are related to social aspects of conservation management (questions 3, 10, 23, 24, 25, 40), staffing capacity (questions 16, 19, 28)

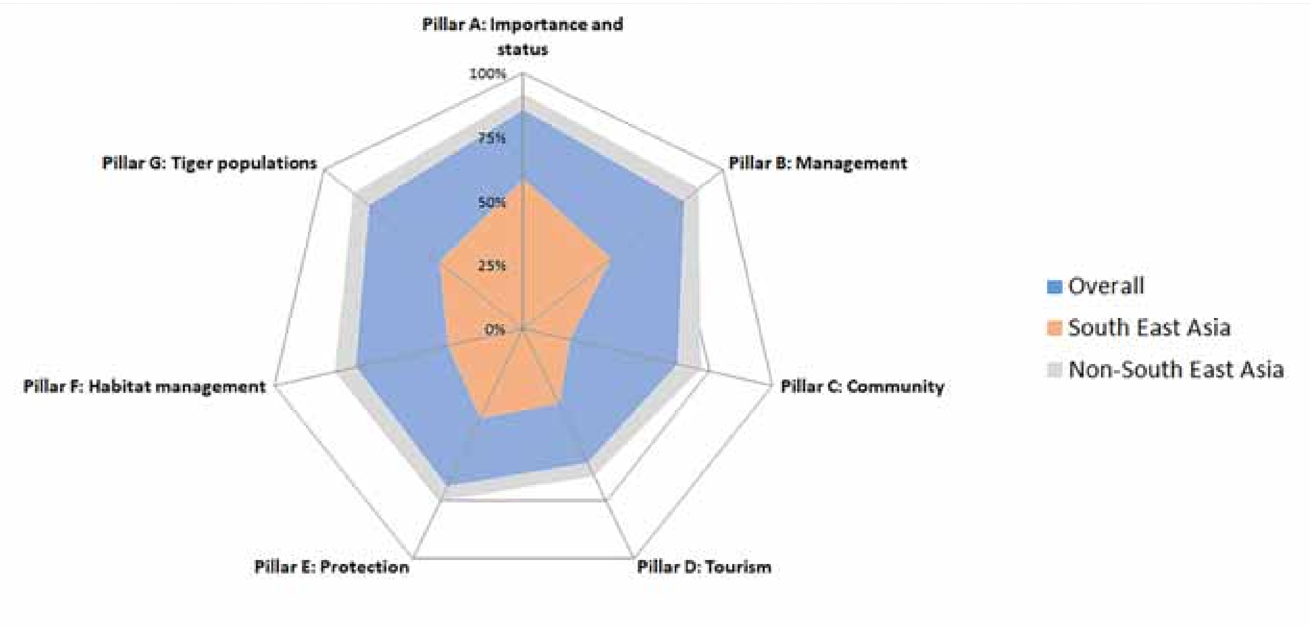

Figure 2. Percentage of surveyed TCAs that have either implemented (score of 1) or initiated (score of 0.75) actions based on the seven CA|TS pillars. Compares responses from TCAs in South East Asia (n = 20) (inner ring), non-South East Asia (n = 91) (outer ring) and overall (n = 111) (middle ring)

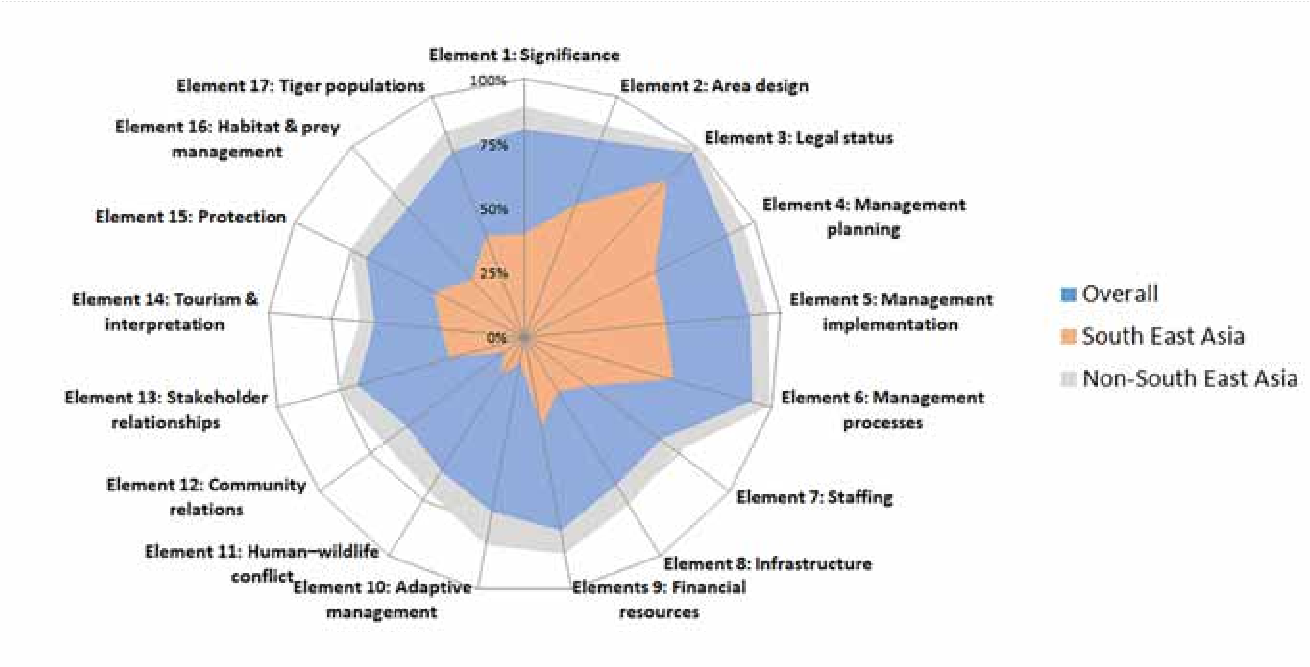

Figure 3. Percentage of surveyed TCAs that have either implemented (score of 1) or initiated (score of 0.75) actions based on the 17 CA|TS elements. Compares responses from TCAs in South East Asia (n = 20) (inner ring), non-South East Asia (n = 91) (outer ring) and overall (n = 111) (middle ring)

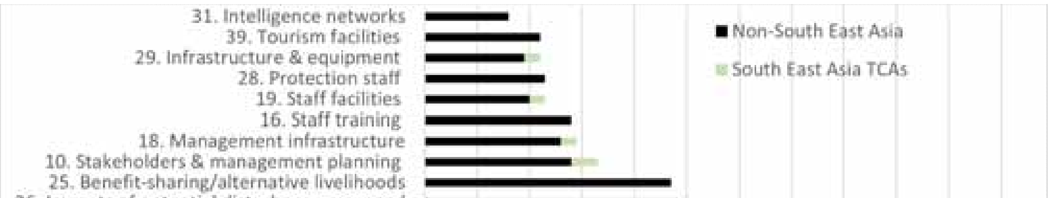

Figure 4. Number of sites surveyed (n = 111) with maximum scores of 1 for each of the 40 questions (see Supplementary Online Material 1). Compares responses from TCAs in South East Asia and non-South East Asia

and protection (questions 26, 28, 29, 31); all amongst the most important aspects of management. The results also indicated weaknesses in management processes; while in total 78 per cent reported that they carry out Tiger monitoring (question 34), fewer (66 per cent) are also monitoring Tiger prey (question 35), and results are not always fed back into management, with 49 per cent of TCAs stating that management is not adaptive (question 21), and 43 per cent stating that they are not using monitoring results to inform management (see question 38). Additionally, three-quarters of TCAs report that they are not sufficiently staffed to fully implement planned management activities (question 16), and a similarly low number of TCAs lack adequate management infrastructure to support staff activities (question 18). The responses from managers in the current survey align with the perceptions of individual rangers surveyed in the region (WWF Tigers Alive Initiative & the Ranger Federation of Asia, 2016).

Figure 4 also reveals that social engagement and community relations are amongst the weakest elements in management. For example, although in total 53 per cent of TCAs report that they involve communities in applicable areas of site management (question 24), only 30 per cent have involved stakeholders in management planning (question 10), meaning that plans have been put together with little engagement of the people that likely affect, or are affected by, a TCA. One exception to this lack of engagement seems to be in the development of tourism. Although many TCAs do not have tourism operations in place, the 56 that do are fully involving communities (question 40). Less than half of the TCAs (42 per cent) have put benefit-sharing/alternative livelihood mechanisms (question 25) in place, and no TCAs in South East Asia have mechanisms of this type fully implemented. While weaknesses exist throughout, TCAs in South East Asia consistently demonstrate weaker management, particularly in community relations, Tiger-specific conservation actions and enforcement of anti-poaching efforts, which prohibit effective protection. Moreover, although many TCAs reported having management plans (54 per cent) (question 8) and annual operational plans (81 per cent) (question 9) implemented or initiated, no TCA in South East Asia reported having management plans fully implemented. These weaknesses are reflected by a continuing decline in Tiger numbers in many of these

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places (Goodrich et al., 2015). There is also a difference between South East Asia and the rest of the TRCs in terms of implementing effective management strategies for human–wildlife conflict (question 22). This includes conflict directly between Tigers and humans and also the impacts of Tiger prey, such as the Wild Boar (Sus scrofa). While 46 per cent of TCAs in South Asia, Russia and China have implemented such systems, only two TCAs in South East Asia have systems initiated and another eight have human–wildlife conflict systems under development.

Poaching is probably the most immediate threat to remaining wild Tigers, making protection strategies critical to their survival (Goodrich et al., 2015; Walston et al., 2010). The survey included six questions (questions 26–31) related to protection and enforcement: protection strategy developed and implemented, threats known and monitored, Tiger protection infrastructure in place, law enforcement monitoring in place, protection efforts intelligence driven, and sufficient staff employed and trained to patrol effectively. The results showed weaknesses in protection and enforcement in general (Figure 4), specifically in South East Asia. Very few TCAs (14 per cent) feel that their protection includes intelligence-driven approaches; the lowest score for any of the 40 questions in the survey (question 31). However, over half (52 per cent) reported that they are in the process of initiating such systems, reflecting considerable capacity development on this issue in the coming years (Conservation Assured, 2018).

Although the survey clearly identified many gaps in management across the Tiger range, it is clear that, for at least some managers, these problems have been recognised and many actions have been planned in response. Across the 20 TCAs surveyed in South East Asia, 196 actions were indicated as being in the planning stage (i.e. an average of 9.8 actions per TCA) as opposed to an average of just four actions per TCA in the rest of the TRCs, where management structures are already clearly more advanced, suggesting a willingness to tackle the current shortfall in management. However, it is not a given that such plans will be realised, as in most cases, existing resources will not be enough. When TCAs report that an action is 'under development', future progress is often funding-dependent. While 86 per cent of TCAs in non-South East Asian countries stated that finances are, or are on the way to being, sustainable, with additional revenue streams maximised and linked to management priorities, only 35 per cent of TCAs in South East Asia are in a similar position.

Finally, if the scores for all the TCAs assessed are plotted (Figure 5), we find that about 10 per cent sites report meeting, or almost meeting, all the criteria in the survey, indicating that they are close to fulfilling the CA|TS

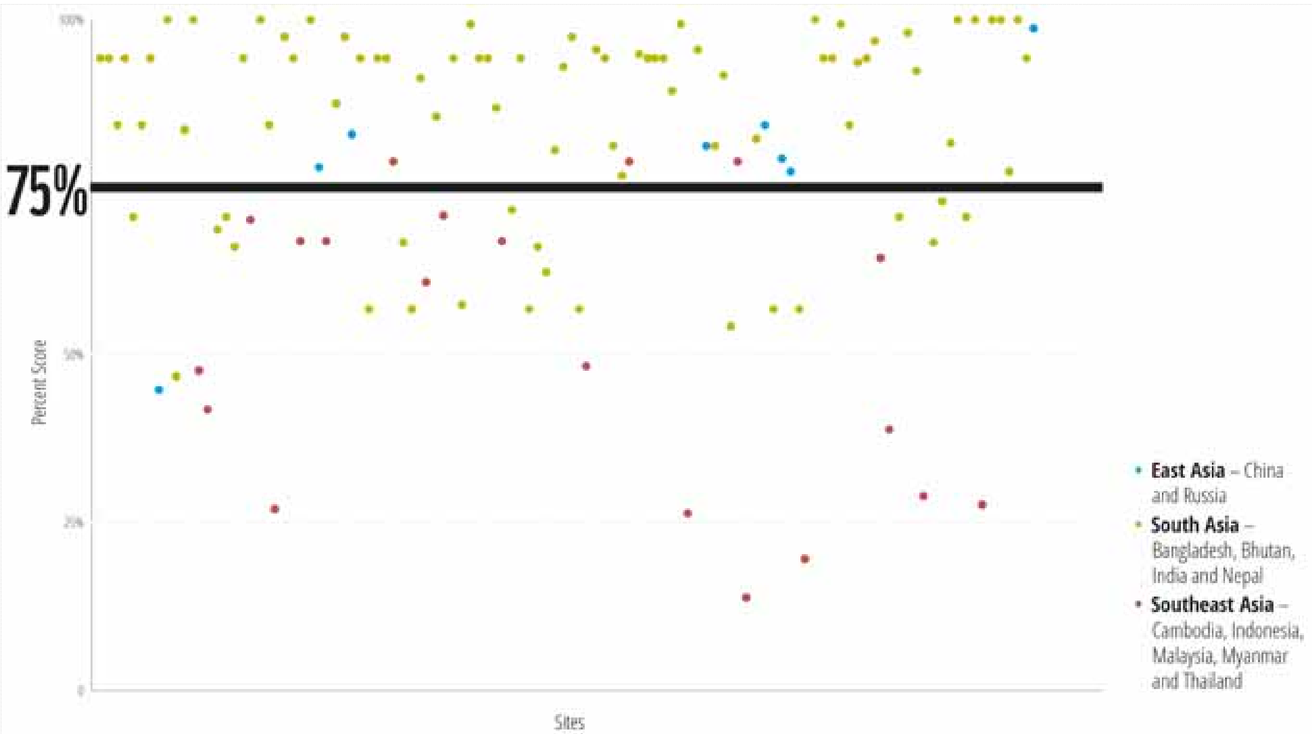

Figure 5. Percent scores for all participating sites in the survey grouped regionally

Approved status requirements. Indeed, six TCAs are now CA|TS Approved and several more are likely to be approved shortly (the current coronavirus pandemic has unfortunately halted much field work and stalled the assessment process). TCAs scoring over 75 per cent (but below 100 per cent) reported fairly strong management, although there are still some improvements needed; 53 per cent fell within this category, suggesting that targeted management investments in these areas could fairly quickly help them reach the CA|TS Approved status and secure wild Tiger populations. Thirty-nine sites fell below the 75 per cent line, indicating relatively weak management or that they are still developing management systems; these sites need to undertake a range of actions. As noted above, all the sites in South East Asia have major gaps in management that prohibit effective protection of their sites.

DISCUSSION

It is critical to have good management in TCAs to halt and reverse the decline of wild Tigers. This study is geographically the widest Tiger-specific assessment of management to date. The results suggest that despite a welcome increase in attention paid to Tiger conservation, serious weaknesses in management remain, even in places that are specially designated for Tiger conservation. This is particularly the case for South East Asia. If the trends indicated here hold true across the region, then 35 per cent of TCAs are at risk of serious declines in their Tiger populations, impacting the chances of reaching the goal of doubling wild Tiger populations by 2022 across the remaining Tiger range.

The rapid survey used to investigate Tiger management practices against the CA|TS criteria was based on self-assessment, with the limitation that this implies,

Tiger, Pench Tiger Reserve, India © Shrirish Kathikar although the results are consistent enough to provide an important contemporary picture of Tiger management and to identify some important next steps in Tiger conservation. Self-assessment surveys are vulnerable to bias, although previous research suggests that, if anything, protected area managers tend to be more self-critical than outside assessors (Hockings et al., 2006). The fact that only a few of the TCAs judged themselves to meet what international experts have identified as effective standards of management for TCA suggests that respondents have not painted an overly optimistic picture of their operations. Indeed, the TCAs that did score highly in the survey have gone on to become CA|TS Accredited (Pasha et al., 2018), meaning that their management has been through the full assessment and independent review process developed by CA|TS (Conservation Assured, 2020). While some issues, like the adequacy of staffing levels, are well-known to be difficult to assess (few protected areas will say they are adequately staffed), the fact that managers' opinions match those of rangers (WWF Tigers Alive Initiative & the Ranger Federation of Asia, 2016) also provides greater assurance.

More worrying for overall Tiger conservation is the large discrepancy in reporting between countries. Indeed, it might be inferred that the better managed and resourced TCAs are more likely to respond to the survey, making the 'at risk' sites an even higher percentage of the total. The strong reporting from India, generally judged to have some of the most effective Tiger conservation based on their increasing wild Tiger populations (Jhala et al., 2019), has likely biased the perception of overall effectiveness; hence the need to disaggregate results into regions. As the survey indicates, few TCAs are truly effective refuges for Tigers, and this has been a contributing factor in the catastrophic decline of Tiger numbers in recent decades.

It is encouraging to find that many governments in the region are already demonstrating commitment to the future of wild Tigers (GTI, 2010). However, it is worrying that the lack of investment in some sites, particularly in South East Asia, is hampering conservation, so that even within protected areas, there have been disproportionate levels of Tiger losses in recent decades (Walston et al., 2010). Addressing this shortfall remains one of the most urgent tasks needed to ensure the future of wild Tiger populations.

From the practical perspective of the next steps in Tiger conservation, the results suggest that actions need to be tailored to a range of contexts (see for example, Harihar et al., 2018). Some TCAs are manifestly failing and need support in the form of both increased funding and policy support from their own governments and targeted support from donors, NGOs and others to aid basic capacity building. In other cases, the remaining requirements are more specific, particularly in terms of policies and training in relation to the management of stakeholder relations and enforcement. In some of these cases, region-wide initiatives and developing training packages may be an efficient way of moving forward. Participatory approaches, for example, require skills; building these with managers and staff is a clear step towards strengthening management.

Barasingha (*Rucervus duvaucelii)* in Kanha Tiger Reserve
© MKS Pasha

Finally, to continue to track improvements and changes in TCA management and ensure the long-term survival of wild Tigers, a comparative study is being planned to assess progress in TCA management every two years.

SUPPLEMENTARY ONLINE MATERIAL

A blank version of the survey has been provided.

ACKNOWLEDGEMENTS

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

The survey was been conducted with the help of several agencies, individuals, experts and CA|TS Support Group members (e.g. site managers through their respective departments); Forest Department, Bangladesh; Department of Forest and Park Services of Bhutan; Department of Nature Conservation and Protection, Cambodia; Ministry of Environmental Protection, China; Ministry of Environment, Forests and Climate Change, National Tiger Conservation Authority and State Forest Departments, India; Department of Wildlife and National Parks and Perak State Parks Corporation, Malaysia; Nature and Wildlife Conservation Department, Myanmar; Department of National Parks and Wildlife Conservation, Nepal; National Parks and Nature Reserves of Russian Far East; Department of National Parks, Wildlife and Plant Conservation, Thailand; WWF country focal points for CA|TS). The Global Tiger Forum (GTF), UNDP, IUCN-KfW and WWF were the main collaborators.

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Tiger, Pench Tiger Reserve, India © Shrirish Kathikar

RESUMEN

El compromiso mundial de duplicar las poblaciones silvestres de Tigres para 2022 ha centrado la atención en la necesidad de una gestión eficaz de la conservación. La herramienta Conservation Assured | Tiger Standards (CA|TS) fue creada para identificar buenas prácticas de gestión para los tigres y promoverlas dentro de las áreas de conservación del Tigre (TCA, por sus siglas en inglés). En el estudio que aquí se presenta se evaluó la gestión de las TCA frente a una versión simplificada de CA|TS para revelar posibles deficiencias en la gestión y ofrecer recomendaciones para prácticas futuras. De 11 países del área de distribución del Tigre (TRC, por sus siglas en inglés), 111 TCA fueron objeto de estudio con respecto a la implementación de 40 actividades estratégicas relacionadas con la gestión de los Tigres, convirtiéndose en el mayor estudio realizado a la fecha sobre la gestión del tigre. En el estudio se constató que más de un tercio de las TCA presentan importantes deficiencias de gestión, que amenazan la supervivencia de los Tigres silvestres, la biodiversidad y los recursos naturales. Dichas deficiencias son especialmente notables en los países de Asia sudoriental en comparación con otras TRC. Los países no pertenecientes al sudeste asiático tenían un porcentaje considerablemente mayor de TCA que habían implementado plenamente las actividades descritas en el estudio. Los elementos de gestión que obtuvieron la puntuación más baja, excluyendo el turismo, por cuanto no se aplicaba a todas las TCA, fueron la infraestructura, el equipo y las instalaciones, la protección y las relaciones con la comunidad. Las recomendaciones incluyen el aumento de la financiación gubernamental, la creación de capacidad y la implementación de (CA|TS) para asegurar el futuro de los Tigres silvestres.

RÉSUMÉ

Un engagement mondial visant à doubler les populations de Tigres sauvages d'ici 2022 a fait ressortir la nécessité d'une gestion plus efficace de leur conservation. Un outil d'avant-garde appelé le Conservation Assured Tiger Standards (désigné par le sigle anglais CA|TS) a été déployé pour identifier de bonnes normes de gestion pour les Tigres puis les promouvoir dans leurs aires de conservation (désignées par le sigle anglais TCA). L'étude présentée ici a évalué la gestion des TCA sur la base d'une version simplifiée du CA|TS afin de découvrir les lacunes potentielles dans la gestion et de fournir des recommandations pour de futures pratiques. Dans 11 pays de l'aire de répartition du Tigre (désignée par le sigle anglais TRC), 111 TCA ont été interrogées sur leur mise en œuvre de 40 activités stratégiques de gestion du Tigre, ce qui en fait la plus grande étude de gestion du Tigre à ce jour. L'étude a révélé que plus d'un tiers des TCA présentent des lacunes de gestion majeures, menaçant la survie des Tigres sauvages, la biodiversité et les ressources naturelles. Ces lacunes sont particulièrement importantes dans les pays d'Asie du Sud-Est par rapport aux autres TRC. Les pays asiatiques hors zone Sud-Est présentent un pourcentage nettement plus élevé de TCA ayant pleinement mis en œuvre les activités décrites dans l'enquête. Les éléments de gestion les moins bien notés, en excluant le tourisme qui ne s'applique pas à toutes les TCA concernées, étaient les infrastructures, les équipements et les installations, la protection et les relations communautaires. Les recommandations de l'étude comprennent l'augmentation du financement gouvernemental, le renforcement des capacités et la mise en œuvre du CA|TS pour assurer l'avenir des Tigres sauvages.

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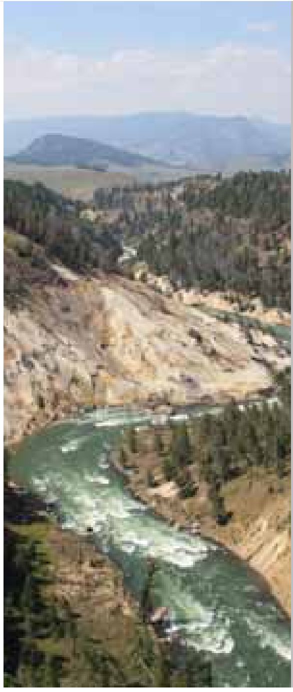

SHORT COMMUNICATION
TOWARDS A TYPOLOGICAL FRAMEWORK FOR AREA-BASED CONSERVATION

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ABSTRACT
Protected areas and other area-based measures are widely accepted as key elements in biodiversity conservation. However, the diversity and inconsistent usage of terms used to describe these measures have often led to confusion. This has sometimes hampered discussions on their role, including in the Post-2020 Global Biodiversity Framework. Here, we seek to provide some clarification of the most widely used terms describing different measures of area-based conservation by proposing a typological framework. This framework considers three area-based conservation types, which are not mutually exclusive: A. 'Areas dedicated to, and/or achieving, the conservation of nature'; B. 'Areas subject to specific governance and/or management relevant to the conservation of nature'; and C. 'Areas identified as priorities for the conservation of nature'. We hope that this framework will contribute to a better understanding of the different types of area-based conservation and help inform the development of new targets and indicators for the Post-2020 Global Biodiversity Framework.

Key words: protected area, other effective area-based conservation measure (OECM), conservation typology, management, governance, conservation priorities

INTRODUCTION
The establishment of area-based conservation measures, such as protected areas, has been an important element of the Strategic Plan for Biodiversity 2011-2020 (CBD, 2010). The adoption of a Post-2020 Global Biodiversity Framework provides an opportunity to set ambitious new targets for conservation of nature (CBD, 2020). These new goals and targets will be agreed and adopted at the upcoming fifteenth Conference of the Parties to the Convention on Biological Diversity (CBD).

As with the current Strategic Plan's Target 11, protected areas (PAs) and other effective area-based conservation measures (OECMs) are proposed as the focus of Target 2 in the Zero Draft (CBD, 2020), which states: "By 2030, protect and conserve through well connected and effective system of protected areas and other effective area-based conservation measures at least 30 per cent of the planet with the focus on areas particularly important for biodiversity".

Recent studies have shown that a variety of area-based conservation measures are needed to safeguard biodiversity in the terrestrial (e.g. Locke et al., 2019) and marine realms (e.g. Jones et al., 2020). Conservation scientists overwhelmingly consider in-situ conservation to be essential and support large-scale area-based conservation targets, with a focus on PAs in areas identified as important for biodiversity (Visconti et al., 2019; Woodley et al., 2019).

The proliferation of terms used to describe area-based conservation measures has led to some misunderstandings on what is, and should be, reported to the World Database on Protected Areas (WDPA), the primary dataset used to report on Aichi target 11 (WDPA team, pers. comm.). This has led to further confusion over the role of different measures in nature conservation, including in the Post-2020 Global Biodiversity Framework.

Using a common language will help to improve the recognition, reporting and management of area-based conservation measures, including clarifying which global targets they support. Here we propose a typology of terms that have an agreed definition and are commonly used to describe different types of area-based conservation. Our proposal considers three types of area-based conservation. We describe each type and provide several examples. We conclude by suggesting how a better understanding of these different types could improve their recognition and implementation.

PROPOSED AREA-BASED CONSERVATION TYPOLOGY FRAMEWORK

As detailed below and in Figure 1, we propose three types of area-based conservation measures:

A. Areas dedicated to, and/or achieving, the conservation of nature;
B. Areas subject to specific governance and/or management relevant to the conservation of nature; and
C. Areas identified as priorities for the conservation of nature.

A. Areas dedicated to, and/or achieving, the conservation of nature

This type includes areas that meet the globally agreed definitions of PAs (CBD, 1992; Dudley, 2008; Lopoukhine & Dias, 2012) and other effective area-based conservation measures (OECMs) (CBD, 2018; IUCN, 2019), the two types included in Aichi Biodiversity Target 11 in the Strategic Plan for Biodiversity 2011-2020. Either term can describe areas under the governance of governments, private actors, indigenous peoples and local communities, or a combination of stakeholders. They may or may not be legally designated.

Protected area (PA)

Multiple international policy processes formally recognise PAs, including the 2030 Agenda for Sustainable Development and the CBD. PAs have been formally defined by the CBD (1992) as "a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives", and by IUCN as "a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008).

There is agreement between the CBD Secretariat and IUCN that the definitions are equivalent (Lopoukhine & Dias, 2012) and they are the definitions used by the World Database on Protected Areas (WDPA). There are, however, over 1,600 different designations from

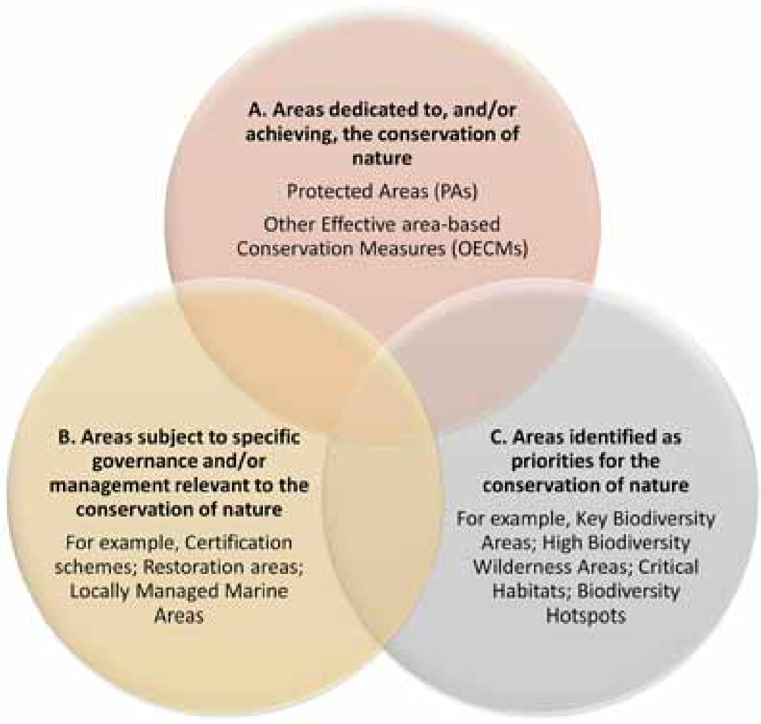

Figure 1. The typological framework proposed aims to clarify the terms commonly used for area-based conservation. These types are not mutually exclusive and may spatially overlap.

international to local level to describe measures that meet these PA definitions, with significant differences in how they are applied between countries. Furthermore, almost a quarter of the world's PAs are protected through more than one spatially overlapping designation (Deguignet et al., 2017).

In 1994, the IUCN General Assembly approved six PA management categories, which classify PAs by their management objectives; these are still in use today. They are: Ia Strict nature reserve, Ib Wilderness area, II National park, III Natural monument and natural feature, IV Habitat and species management area, V: Protected landscape and protected seascape, and VI PA with sustainable use of natural resources. However, there are different interpretations of these categories by countries, and the names associated with each category may be used very differently across countries and may not always correspond to the category as defined by IUCN. For example, PAs called 'national parks' can be found in any of the IUCN categories. Guidance on the correct application is provided in Dudley (2008).

PAs can be under any combination of management categories and governance types (Dudley, 2008), with the latter including governance by government, by private actors, by indigenous peoples and local communities, and shared governance (Borrini-Feyerabend et al., 2013).

The term 'protected and conserved areas' is sometimes used to describe all sites that are, or aim to be, effective in achieving conservation outcomes. Contrary to PAs, which are established with the specific intention of achieving conservation outcomes, 'conserved areas', which still need to be formally defined (Jonas & Jonas, 2019), include a wide range of sites that deliver effective conservation outcomes, but where the area may have been established for other reasons. Included here are those defined by the CBD as OECMs (see below).

Other effective area-based conservation measure (OECM)

A formal definition of OECMs was adopted by the CBD in 2018: "A geographically defined area other than a PA, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values". The World Database on Other Effective Area-based Conservation Measures (WD-OECM) uses this definition as its standard.

Yellowstone National Park, USA, established in 1872 © Elise Belle

While PAs must have nature conservation as their primary objective, OECMs do not necessarily need to. OECMs can be managed for many different objectives, but also have to deliver effective conservation of nature. IUCN (2019) provides practical guidelines for recognising and reporting them.

OECMs can broadly be divided into three kinds:

1. Ancillary: when conservation of nature is a by-product of the area's management;
2. Secondary: when conservation of nature is an objective, but other objectives take priority; and
3. Primary: when an area has conservation of nature as a primary management objective, but its governance authority wishes it to be recognised as an OECM rather than as a PA.

Another type of area-based measure to be considered in the future is ecological corridors. These are areas within ecological networks devoted to ecological connectivity, which can also contribute directly to conservation (Hilty et al., 2020). Guidance was only published recently, meaning that they have yet to be widely taken up, and their position in the typological framework is not yet clear.

B. Areas subject to specific governance and/or management relevant to the conservation of nature

This type refers to various classifications of specific management and/or governance measures with objectives relevant to the conservation of nature, and/or that result in effective conservation. As they are defined from a different starting point, they may be a PA, an OECM, or meet neither definition, and the exact status of any such areas needs to be considered on a case-by-case basis.

Some areas are defined by governance (e.g. 'Territories of Life', or ICCAs, are defined in part as areas under the governance of Indigenous peoples or local communities), or management (e.g. 'restoration areas' all share restoration objectives but may be under any governance type). Some of these areas, like Territories of Life, always achieve nature conservation, as this is part of how they are defined, as "territories and areas conserved by Indigenous peoples and local communities". However, not all areas of this type are defined in this way. For example, agricultural sustainability standards do not always contribute to biodiversity conservation (Tayleur et al., 2016).

Examples of areas under specific management and/or governance that have objectives relevant to the conservation of nature include the following:

- Certification Schemes: voluntary schemes for responsible production and consumption often include measures for area-based conservation.
- Locally Managed Marine Areas (LMMA): nearshore waters, coastal and marine resources managed at a local level.
- Restoration areas: areas managed to assist recovery of an ecosystem that has been degraded, damaged or destroyed.
- Sacred Natural Sites (SNS): areas of land and/or water having special spiritual significance to peoples and communities.

C. Areas identified as priorities for the conservation of nature

These are areas identified as important for the conservation of species, ecosystems and/or habitats, based on specific methodologies to inform the area-based conservation measures described under Types A and B. The main methodologies are:

1. Focusing on specific taxonomic groups (e.g. Important Bird Areas, Important Plant Areas);
2. Using a recognised standard set of criteria (e.g. Key Biodiversity Areas, Ecologically or Biologically Significant Marine Areas); and
3. Applying systematic conservation planning methods (e.g. High-Biodiversity Wilderness Areas).

The identification of their importance is irrespective of the management or governance structures in place. These methodologies are used to identify priorities for conservation. Such areas may overlap spatially with PAs or OECMs (e.g. Jones et al., 2020; Donald et al., 2019). Certain designations can have implications for how an area is managed and/or governed. However, their identification does not imply the existence of any conservation measures.

Examples of areas identified as priorities for the conservation of nature include the following, in alphabetical order (all definitions can be found at www.biodiversitya-z.org):

- Alliance for Zero Extinction (AZE): sites containing the entire population of species listed as endangered or critically endangered on the IUCN Red List of Threatened Species.
- Biodiversity Hotspots: large regions containing exceptional concentrations of plant endemism and experiencing high rates of habitat loss.
- Centres for Plant Diversity (CPD): large regions of global botanical importance based on their endemism and species richness.
- Ecologically or Biologically Significant Marine Areas (EBSA): areas supporting the healthy functioning of oceans and the services they provide.
- Global 200 priority ecoregions: biogeographical regions of the highest importance for conserving the most outstanding and representative subset of the world's habitats.

Bolong Fenyo Community Wildlife Reserve, a Territory of Life located in The Gambia © Elise Belle

- High-Biodiversity Wilderness Areas (HBWA): large intact ecosystems holding significant levels of global biodiversity.
- High Conservation Value Areas (HCVA): areas designated on the basis of their outstanding biological, ecological, social or cultural values.
- Important Marine Mammal Areas (IMMA): discrete portions of habitat important to marine mammal species that can be delineated and managed for conservation.
- Intact Forest Landscapes (IFL): large mosaics of forest and naturally treeless ecosystems which show no signs of human activity or habitat fragmentation.
- Key Biodiversity Areas (KBA): sites contributing significantly to the global persistence of biodiversity.

CONCLUSION AND RECOMMENDATIONS

The recent increase in terms used to describe various types of and concepts linked to area-based conservation has created confusion. One common misconception arises from the fact that different types of area-based conservation often overlap spatially. It is therefore important to note that the different types defined here are not mutually exclusive. They may also exist at varying levels of implementation, from proposals and commitments to fully implemented and actively managed areas.

We hope that this proposed typological framework will stimulate discussions and contribute to improving understanding of the different types of area-based conservation. This should support implementation of international conventions and programmes focused on biodiversity issues, including the CBD, Ramsar Convention and UNESCO Man and Biosphere (MAB) Programme. It could therefore provide an opportunity to improve how sites are designated, monitored and reported, and contribute to ensuring consistency in development of future targets and indicators.

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RESUMEN

Las áreas protegidas y otras medidas basadas en áreas son ampliamente aceptadas como elementos clave para la conservación de la biodiversidad. Sin embargo, la diversidad y el uso inconsistente de los términos utilizados para describir esas medidas a menudo han generado confusión. En ocasiones esto ha obstaculizado los debates sobre su función, incluso en el Marco global para la biodiversidad post-2020. En el presente documento se procura aclarar los términos más utilizados para describir las diferentes medidas de conservación basadas en áreas, mediante el planteamiento de un marco tipológico. Este marco considera tres tipos de conservación basada en áreas, que no son mutuamente excluyentes: A. "Áreas dedicadas a la conservación de la naturaleza y/o su consecución"; B. "Áreas sujetas a una gobernanza y/o gestión específicas relacionadas con la conservación de la naturaleza"; y C. "Áreas identificadas como prioritarias para la conservación de la naturaleza". Confiamos en que este marco contribuya a una mejor comprensión de los diferentes tipos de conservación basada en áreas y que ayude a fundamentar la elaboración de nuevas metas e indicadores para el Marco global para la biodiversidad post-2020.

RÉSUMÉ

Les aires protégées et les autres mesures par zone sont largement acceptées comme éléments clés de la conservation de la biodiversité. Cependant, la diversité et l'utilisation incohérente des termes utilisés pour décrire ces mesures ont souvent généré de la confusion. Cela a parfois entravé les discussions sur leur rôle, y compris dans le Cadre Mondial de la Biodiversité pour l'après-2020. Nous cherchons ici à clarifier les termes les plus couramment utilisés pour décrire différentes mesures de conservation par zone en proposant un cadre typologique. Ce cadre prend en compte trois types de conservation par zone, qui ne s’excluent pas mutuellement. A. «Aires dédiées à la conservation de la nature et/ou réalisant cette conservation»; B. «Aires soumises à une gouvernance spécifique et/ou à une gestion en rapport avec la conservation de la nature»; et C. «Aires identifiées comme prioritaires pour la conservation de la nature». Nous espérons que ce cadre contribuera à une meilleure compréhension des différents types de conservation par zone et pourra servir à orienter l'élaboration de nouveaux objectifs et indicateurs pour le Cadre Mondial de la Biodiversité pour l'après-2020.