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Developing capacity for a protected planet

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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 organisations (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

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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 etc;
- 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
- promoting IUCN's work on protected areas.

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CONTENTS

PARKS: Editorial	6
Exposure of Park Management Staff in Victoria, Australia to Critical Incidents and Trauma: Rethinking Our Approach	7
Anthony English	
Large-scale expansion of marine protected area networks: Lessons from Australia	19
James A. Fitzsimons and Geoff Wescott	
Spatio-temporal analysis of illegal activities from ranger-collected data in W National Park of Benin	35
Tchégoun B. Tchetan, Akomian F. Azihou and Gerard N. Gouwakinnou	
Privately protected areas and biodiversity stewardship in South Africa: Challenges and opportunities for implementation agencies	45
Dale R. Wright, Candice M.D. Stevens, Daniel Marnewick and Garth Mortimer	
Developing Learning Landscape Partnerships: Why and how to work with protected area managers	63
Annie McKee, Kirsty Blackstock, José Miguel Barea Azcón, Paolo Ciucci, Michael Hošek, Michael Huber, Marco Neubert, Carol Ritchie, Andrej Sovinc, Hamish Trench, Zsolt Végyvári and Kathy Velandar	
Harnessing multiple technologies to combat deforestation – A case study in the Alto Mayo Protected Forest in San Martin, Peru	79
Timothy M. Wright, Braulio Andrade, Fabiano Godoy, Jenny Hewson, Eddy Mendoza, Jimmy Pinedo and Karyn Tabor	
Influence of environmental governance regimes on the capacity of Indigenous Peoples to participate in conservation management	87
Tom Duncan, Jaramar Villarreal-Rosas, Josie Carwardine, Stephen T. Garnett and Cathy J. Robinson	



EDITORIAL

Marc Hockings, Managing Editor

As this issue goes to press, conservation leaders and practitioners from around the world will be gathering in Sharm el Sheik in Egypt for the 14th meeting of the Conference of Parties (COP) to the Convention on Biological Diversity. COP14 will consider the issue of Other Effective Area-based Conservation Measures or OECMs – the topic of the Special Issue of PARKS edited by Harry Jonas that was published in the middle of this year.

This will be the last COP before the meeting in Beijing in 2020 when a new plan for conservation of biodiversity will be considered by the nations of the world. Already many efforts are underway to consider what shape the post-2020 targets might take, and we can expect to see some papers relevant to this topic in coming issues of the journal.

Turning to the current issue, the first paper examines the potential impacts on protected area frontline staff from their exposure to various critical incidents and resultant trauma. Sources of trauma vary around the world. Perhaps most significantly there are many countries where rangers are putting their lives on the line every day to stem poaching and the illegal wildlife trade but there would be no countries where rangers do

not face potential trauma from incidents in their daily working lives. Anthony English has considered this issue in the context of one agency (Parks Victoria in Australia) and suggests practical actions and policies to address this issue that will have broader relevance to many jurisdictions.

Two papers in the current issue address the continuing problem of preventing illegal activities within protected areas that can seriously impact on conservation values. Tchetan and his co-authors show how ranger-collected data from patrols can be used to understand the pattern of illegal activities in space and time and to use this understanding to guide planning for enforcement actions. They recommend the use of emerging technologies such as unmanned aerial vehicles to improve monitoring in remote and inaccessible areas. Timothy Wright and colleagues, working in Peru, provide a case study on exactly how such technologies using satellite imagery, unmanned aerial vehicles and acoustic sensors can be integrated to monitor a remote area and combat deforestation.

Three papers touch on different aspects of the partnerships needed to underpin effective conservation management. Dale Wright and co-authors have assessed the challenges and opportunities for agencies implementing biodiversity stewardship arrangements in South Africa. Through their research, they have constructed a model for enhancing collaboration amongst the various players involved in the establishment and management of private land conservation. McKee and her colleagues from across Europe present the results of their investigation of means to enhance effective science-policy interactions through what they have called ‘learning landscape partnerships’ that bring together protected area managers, decision-makers and researchers in a collaborative process. Finally, Duncan and co-authors have examined how different environmental governance regimes affect the capacity of Indigenous Peoples to meaningfully engage in conservation planning and decision-making. Based on a case studies in Australia, they conclude that the potential for such engagement on equitable terms depends on the establishment of “Indigenous-driven co-management regimes” and better recognition of Indigenous worldviews in conservation planning.



EXPOSURE OF PARK MANAGEMENT STAFF IN VICTORIA, AUSTRALIA TO CRITICAL INCIDENTS AND TRAUMA: RETHINKING OUR APPROACH

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ABSTRACT

Park management staff regularly respond to incidents in parks that can lead them to experience or witness trauma. These incidents include assaults, suicides, anti-social behaviour, search and rescue operations, wildfires, and deaths and serious injuries caused by accidents. Exposure can generate what is known as Critical Incident Stress. Staff are often first responders for many of these incidents but are not typically seen by their agencies as performing emergency service functions except when being tasked to fire or flood response. This paper explores how one agency, Parks Victoria, has approached managing staff exposure to trauma. It argues that historically, there has been a focus on the management and prevention of physical injuries in the workplace, and a tendency to restrict recognition of stress impacts on staff to those incidents tied to natural disasters such as wildfires. Numerous strategic actions to address this shortfall are suggested and explored. The discussion has relevance to other park management agencies and reflects the author's experience working in park management in different parts of Australia over the last twenty-five years.

Key words: Critical incidents, trauma, park management, organisational resilience

INTRODUCTION

A career in park management brings many unique and unforgettable experiences. Opportunities to care for the environment, be part of a team, and serve the community are just some of the elements that make these careers fulfilling.

There are, however, other aspects to these jobs, especially in operational roles, that are not commonly associated with either the public's perception of 'rangering', or the way that agencies themselves describe these roles when advertising or managing them as part of a workforce. Exposure to traumatic events, or what at times can be classed as 'critical incidents', are for many an element of their working life.

In a park setting they can include assaults, drownings, suicides, homicides, vehicle accidents, rock climbing and mountain bike accidents, search and rescue operations, vandalism, animal welfare incidents and anti-social behaviour. Park staff may be first responders or support the work of other emergency services in these situations. In some parks, these types of incident may occur on numerous occasions during a year. Occasionally, park staff may experience situations where their lives are threatened or lost.

The scale or severity of incidents can vary greatly. At the most severe are what are termed Critical Incidents. These are events that overwhelm an individual's or group's capacity to cope with what they have experienced (Lunn, 2000, p.48; US Forest Service, 2014, p.4). Critical incidents include, but are not limited to, those incidents where staff feel that their safety or life has been put at risk, and where staff have witnessed death or serious injury. Critical Incident Stress (CIS) may eventuate from exposure to such events. At the same time, an accretion of exposure to repeated events that may not all be critical, but still associated with trauma, can generate an impact on a person's well-being (Jenner, 2007, p.26).

This paper seeks to examine how one agency, Parks Victoria, has responded to the exposure of staff to trauma, critical incidents and CIS in the workplace. Both formal and informal approaches to CIS and its management are discussed and the trajectory of the agency's recognition or awareness of CIS is explored. In doing so, the paper draws a picture that is potentially reflective of how park agencies in other jurisdictions in Australia have tackled this challenge. It is important to note at the outset that the author's perspective is based

on insight gained as an employee in three Australian park agencies, not as a health professional.

The objective of this paper is not to portray a career in park management as being inherently traumatic. These careers are typically associated with positive, life-affirming experiences in strong and resourceful teams. However, there is significant potential for staff to experience involvement in a traumatic incident at some point, either during what might be termed 'normal duties', or as part of a structured response to significant natural events such as wildfires. This exposure may also accumulate across a career. While forming what may only be a small fraction of the overall time worked by employees, this exposure can have a significant impact on staff and, by extension, their families.

Agencies such as Parks Victoria have an opportunity to formally acknowledge this reality and establish systems of work and staff management that prepare and support staff and their families to develop a capacity for resilience. A key argument made here is that a connected, resilient organisation is one of the most essential ingredients in creating a workplace that effectively prepares and supports staff in the face of trauma. We need to ask whether park agencies, as they experience change, are managing to build or retain this resilience. Without this characteristic, organisational mechanisms put in place in response to CIS and stress more broadly may not ring true with staff and be perceived as 'off the shelf' responses rather than genuine strategies that reflect the dynamic of park workplaces and team culture.

PERSONAL REFLECTION ON PAST PRACTICE

Many years ago, I commenced my first day as a ranger in a busy national park. My induction involved being shown key visitor facilities such as picnic grounds and toilets. Standing outside one of these toilet blocks, my experienced colleague explained that this was frequently a location where people died of drug overdoses. Being new, I did not think to ask many questions about what our role was if we encountered someone in this circumstance. Fast forward over many years and in a role as a District Manager I found myself managing teams that have an infrequent but regular exposure to incidents such as suicides and attempted suicides by members of the public, accidents and search and rescue events. Looking back over my career, I can readily recount a list of incidents, some critical, to which I and my team members have been required to respond. In some cases, these incidents have involved exposure of team members to significant personal risk, witnessing death or serious injury, and the associated reactions and distress of victims and their families.



The vast majority of interactions between park visitors and staff are positive. Park staff can however experience aggression or anti-social behaviour that affects their wellbeing © Parks Victoria

I have worked with peers who have had repeated exposure to death and serious injury in the parks they manage. These experiences are overlaid on other professional stressors associated with organisational restructures, workloads and erratic budgets.

I have begun to look critically at how I as a manager, and my organisation, plan for and respond to such contingencies. While there are many examples of effective small-scale responses, there is a general failure of Australian park agencies to adopt a strategic approach to workforce management that embeds within it an analysis of the challenge and potential ways to manage or limit staff exposure.

CHARACTERISING THE CHALLENGE

The veracity of this personal observation needs to be tested by looking at recorded information about incidents and their frequency. To achieve this, I sought to review the database of formal incident reports held by Parks Victoria relating to incidents involving members of the public that were attended by staff members.

Data covering the period 2013-2016 revealed that up to 700 events were logged that had the potential to

generate staff exposure to a critical incident or a level of trauma during that time. This looks to be a significant number of events across a workforce of only around 1,000 people. Importantly, this figure did not include data relating to wildfires, floods or workplace accidents or injuries. The types of events listed in the database included vehicle accidents, drownings, suicides, assaults, theft of personal property, unsociable behaviour by visitors, vandalism and search and rescue operations. The database suggests that most of the recorded incidents tended to be of short duration, and each involved in most cases only a handful of staff.

Analysis of the data was hindered by many factors. The classification system for event types changed during the period reviewed, many entries were incomplete, and a large number were logged as being 'unspecified'. Without going to the actual individual reports, it proved impossible to determine the true nature of a large proportion of the events. It was also not possible from

many of the records to determine whether staff members were directly exposed to the incident, first responders, or working in a support agency role.

The database could not therefore be used to accurately characterise the type and frequency of incidents occurring on the park estate. This itself reflects an underlying issue; namely the lack of structured attention by the agency to these incidents as repeat and significant elements of the workplace. Clearly, the information collected could not easily be used by the organisation to track patterns in incident type, or the exposure of individual staff to incidents across the span of their careers. Such knowledge rests instead with the informal collective awareness of individual teams, and with the respective staff members themselves.

Importantly, there was also no associated or linked data captured on internal Occupational Health and Safety (OH&S) systems about exposure to trauma. In effect, the



Fire response is a core element of most staff member's careers at Parks Victoria. While this experience can generate critical incident stress, many other, and often more frequent incidents that are not fire-related, can have the same effect. © Anthony English

Incident Reporting system was, and remains, separate from OH&S reporting. OH&S reporting itself does not provide a field for entering exposure to trauma as a hazard or issue. In this way, the mental well-being effects of the incidents are not captured well in either system.

It is important to point out that studies suggest that many of the incidents of the type referred to here do not necessarily generate any long-term health impacts on employees (US Forest Service, 2014, p.5). A recent Australian investigation of effects on emergency service staff suggested that many staff members have, or develop, a level of resilience that allows them to cope with and rationalise their exposure. It argued that between 10 and 30 per cent of emergency services staff can develop post-traumatic stress disorder (PTSD) from attending a traumatic event and that of those, 10 per cent need support beyond that of peers, friends and family to recover (WA Parliament, 2012, p.5).

Stress can also have a scale of severity, and many incidents may not generate anything beyond a low-level response due to their nature or the role performed by staff at the event. Individual response to stress is shaped by a wide array of factors and it has also been pointed out that responders can gain affirmation from their work at incidents such as a sense of achievement, teamwork or having provided an important service to the community (Jenner, 2007, p.26; Holgate & Di Pietro, 2007). Nevertheless, the potential for negative exposure to serious or critical incidents at Parks Victoria appears, on the basic analysis presented here, to be high.

In the absence of effective data, personal observation as an operational manager can be used to identify other dimensions to critical incidents in parks that shape the challenge for park agencies and their staff. These include the fact that firstly, in remote areas, staff members may need to perform a broader array of first response tasks as it can take time for other emergency services agencies to arrive on scene. This can also apply in less remote settings because emergency services may be stretched and park staff may have to provide first response skills even in urban parks.

Secondly, these incidents are occurring in the workplace. They are not events that are witnessed on the street. As such they may form part of the overall perception of the workplace by staff, and form part of the personal history of a staff member's service.

Thirdly, and perhaps most importantly, the type of incidents discussed here arise during a normal working

day when staff are not focused on the need to undertake emergency service tasks. In this way these incidents differ markedly from structured deployment to a large fire campaign. In the latter case, a team may be briefed and provided with information that prepares them for the event they are responding to. In contrast, the myriad of non-fire incidents described in this paper may arise at a moment's notice when a staff member is least expecting it. One minute they may be in the office taking phone calls or out maintaining park facilities. The next they may find themselves coming across an incident, some serious, others less so. Arriving at a picnic area they may encounter an assault taking place. Driving around a bend in a track they may encounter a vehicle accident. These incidents are typically rapid in their onset and resolution and often are followed by a staff member seeking to return almost immediately to the task they were conducting before the incident occurred.

This reality generates a very different challenge for park agencies than that experienced by more emergency service focused organisations. It suggests that approaches to preparing park staff for exposure to trauma and supporting them to resume normal duties may be required that differ from those used in other organisational settings. The place of traumatic incidents in the rhythm of staff work patterns certainly calls, I believe, for a specific form of leadership, agency culture and internal conversation.

It is this challenge and its complexity that has partly shaped the lack of strategic focus by park agencies on this element of their workforce's experience. It has been far easier to see staff as undertaking emergency services work when attending fires and floods. Whereas other non-fire related incidents have effectively been viewed as unfortunate interruptions to 'normal' duties, rather than being an embedded element of a staff member's role. As we will see, agencies like Parks Victoria have tended to rely on teams themselves to self-manage post-incident staff support in these circumstances. These approaches have been shaped by, and are as variable as, the dynamic of individual teams and the attitude or awareness of individual managers.

Finally, some of the incidents experienced by staff in a park such as a fire can create long-term consequences for teams that require them to constantly re-engage with the original event. As an example, the work that goes into recovering the natural and built assets of a park after a fire can encompass years of effort. The landscape itself can bear the scars of an incident for a long time.

Overlaying these, and other factors, is the fact that careers in park agencies have historically tended to be



Parks are unique workplaces that inspire staff, many of whom develop close attachments to the landscapes they work in. This sense of connection to place can be a key factor in the development of staff resilience and their capacity to manage the effects of critical incidents on their wellbeing © Anthony English

lengthy. This can create a situation where staff members accumulate exposure to incidents either on an infrequent or semi-regular basis across their thirty or forty years of service.

CURRENT APPROACHES AT PARKS VICTORIA

What then has shaped the historical approach of organisations such as Parks Victoria to managing critical incidents and staff exposure to trauma? Five key drivers are posited here as being primary contributors:

- Parks Victoria's approach to this challenge, and perhaps that of other park agencies, is reflective of broader societal responses to stress and trauma in the workplace;
- Critical incidents have tended to be seen by the agency as being primarily tied to large-scale fire or flood events. The plethora of small-scale, but more frequent events, have not been managed or perceived as fitting into this category;
- Agencies such as Parks Victoria have relied implicitly on their operational teams to handle or manage exposure to trauma themselves; and
- OH&S attention in the workplace has been traditionally focused on physical injuries and risks.

We can explore these elements in turn.

Park agencies reflecting social norms

Park agencies such as Parks Victoria are not alone in their lack of effective attention to critical incidents and stress in the workplace. Many, if not most, sectors in the Australian workplace have been on the same slow path to broadening their attention beyond physical injuries and their prevention, to consideration of staff well-being and mental health. Perhaps this has been reinforced in park agencies by the historical image of the ranger as being a hardy, resilient jack of all trades who is able to get on with the job in the face of hardship. We need to ask whether this image has created a blind spot in park agencies themselves and obscured the reality of these roles and the effect of exposure to trauma on staff. As historically male dominated workplaces, park agencies have also reflected overarching cultural norms that are tied to treating stress as a private matter that staff members should 'deal with' themselves. The influence of gender on internal cultures in this context was highlighted by a Western Australian Parliamentary Committee review of the effects of trauma on emergency service staff (Parliament of Western Australia, 2012, p.6).

At the same time, apart from a few well-known examples such as the Azaria Chamberlain case, parks and reserves in Australia are not talked about or perceived as being sites of potential trauma. Rather they are valued, and marketed as places to recuperate, be inspired and seek solace from stress. While this is true, they are also workplaces where the staff responsible for them can at times confront both low level and significant trauma. There can be a tension between the lived experience of staff, and the way that agencies themselves talk about parks and their management both internally and in the public domain.

The lack of published literature on the experience of staff in park agencies is illustrative of this form of organisational silence. Writing on this topic in Australia is limited and it is hard to find published material that addresses the subject. Conroy's (2016) paper on a park agency's response to the effects of the loss of staff at a hazard reduction burn at Mount Kuring-Gai in 2000 is a rare example. He emphasised the importance of peer support, support for families and tools such as return to work planning, staff transfer (at their request), and good senior leadership.

Australian literature on emergency services staff and community responses to critical incidents and CIS such as Lunn (2000), Gordon (2006) and Jenner (2007) provides significant insight that can be translated to a park agency setting. Nevertheless, there appears to be little evidence that park agencies and their staff have been a specific focus for researchers in this context. Equally, as noted above, the place of incidents in the rhythm of a park agency staff member's working week, may mean that we need to consider strategies that differ from those suggested in other emergency service agency settings.

In the United States, by contrast there has been significant investment made in understanding critical incidents stress within park and land management agencies, and developing formal procedures for equipping and supporting staff to face their effects. There are a few well-known publications that touch on the subject; one of the most dramatic being Lankford (2010). United States land and fire management agencies have a much longer history of developing CIS strategies designed to tackle its effects on the workforce. Within the US National Park Service, this commenced in the early 1980s, initially as Critical Incident Stress Debriefing (CISD), then as more holistic Critical Incident Stress Management (CISM) approaches focused on development of peer support teams and the organisation of targeted expert psychological support (Bucello, 1998; Collins, 1998). It has since evolved again

to form larger programmes that focus on developing pre-event resilience in staff through Psychological First Aid and the development of training and resources for managers and staff (see for example, US Forest Service, 2014).

The focus on large-scale natural events

Over the last decade or more, staff at Parks Victoria have been involved in many significant fire seasons. Staff members serve in a broad range of roles at these incidents; on fire grounds as operational fire fighters, in Incident Management Teams, and as members of teams that work on post-event recovery, often with local community members. It has been here, in a cross-agency emergency management context that Parks Victoria has been both exposed to and advanced a level of recognition of CIS and lower levels of stress in the workplace.

These events can, and do, generate the potential for stress, fatigue and long-term impacts to staff well-being. As an example, the Black Saturday fires in Victoria in February 2009 have been discussed as a source of PTSD in the ranks of agency staff, other firefighters and the broader community (Stanley, 2013; Parliament of Western Australia, 2012; and pers. obs.).

In such post natural disaster settings, agencies like Parks Victoria have typically responded to the need to manage impacts on staff by undertaking formal debrief and after-action review (AAR) processes. Importantly there appears to be a growing body of thought that actively questions formal AARs as an effective approach to supporting staff who have experienced trauma (Lunn, 2000). AARs have tended to be focused on reviewing how an operation was carried out, and whether tactical changes can be made to ensure the next response is run more effectively. In my experience, they have rarely been an effective vehicle to discuss how staff feel about an event, or to talk in genuine terms about stress.

Opportunities are also often established after large natural disaster events to support staff at an individual level when they have been exposed to trauma. Even in these cases, however, this tends to focus on short-term response and quite limited formal support. This situation is compounded by the fact that managers are not provided with training to allow them to identify or support the need for more extensive support services either in the short or longer term.

A focus on physical injuries and their prevention

As well as a tendency to consider stress and trauma only in the context of large-scale fires, there has been a long-

standing focus on the prevention and management of physical injuries in the workplace. This focus is either a by-product of an inability by agencies to encompass consideration of non-physical injury, or a driver of this situation. It is a focus that is reflected in current internal and external Parks Victoria documents such as the most recent annual report (Parks Victoria, 2017). At depot and office level it has manifested in the last few years in a variety of ways including the re-establishment of injury rate boards at work centres that show how many days it has been since each site has experienced a lost-time injury.

One of the drivers for this focus may be that physical injury and risks are often more easily quantifiable and linked to 'evidence' such as near miss reporting. Strategies to lower the frequency and extent of these injuries are also more easily tied to statistical benchmarks reflecting 'industry standards'.

Reducing and preventing physical injuries in the workplace is, of course, vital. There has been a significant and positive shift to improved safety cultures addressing risk of physical injury in park agencies over the last 25 years. Parks Victoria is a good example of this. As an agency it has undergone a transformative focus on safety that is built on the need for safety, and safety systems, to be a day-to-day focus of staff and managers. The use of safe working practices is linked to the accountability placed on line managers, and there is an increasing pride amongst teams in working safely and developing innovative ways to enhance safety in the workplace. This is critical given that many of the tasks undertaken by staff are associated with risk. Operating heavy plant and machinery, handling chemicals, working in rough terrain, conducting planned burns and patrolling, all come with risks that staff and the agency work hard to mitigate.

As this safety culture has evolved, there has been some limited attention given to non-physical injuries. Parks Victoria have for over ten years provided services to staff such as Employee Assistance Programs (EAP) that allow employees to receive up to three free and confidential counselling sessions. Nevertheless, the role of the EAP service in workforce management and support has not been linked to a broader, meaningful and well led conversation in the agency about stress. A culture that supports and promotes the importance of mental health well-being has not been developed at an agency level. This has meant that promotion of EAP has often generated very little take-up by staff. Instead, EAP has tended to be referenced at the end of management emails about organisational change as something staff should consider if they are feeling distressed.

A reliance on team level management

It is at the team level, at the scale of individual work centres of Districts, that I would argue different approaches have evolved first. Operational teams in park agencies tend to be close knit and to contain an in-built resilience that is developed through shared experience and commitment to the job. This is not unlike the camaraderie that exists in emergency service organisations more broadly (Silbauer, 2003). This strength has no doubt assisted many staff members to develop resilience and to find effective support.

Despite this, it is now clear that such a team culture does not prevent staff from experiencing the effects of exposure to trauma. It is also likely that internal team cultures have historically been characterised by a lack of active discussion about the effects of incidents on team members. A focus on 'getting on with the job' and putting these experiences to one side has, in my experience, been a common past response.

This is changing. It is now more common that staff and line managers 'check in' with each other after a significant incident has occurred. More explicit discussions between line managers about how a staff member is 'travelling' after an incident are also more frequent than may have been the case ten or fifteen years ago. Managers may also choose to bring in specialist expertise and to work with their teams to improve their approach. Importantly, as operational managers we are being increasingly supported to take this approach by corporate based safety staff. This reflects a gradual shift to a workplace culture that is more comfortable acknowledging mental health well-being and the reality of critical incident stress.

This indicates that the need for this approach is now being reassessed within Parks Victoria at a whole of agency level. In part, this has been driven by broader societal trends and expectations. Mental health and well-being are becoming an increasingly common topic of conversation in the media, community and workplace. Initiatives in Australia such as RU OK Day (<https://www.ruok.org.au>), and the work of bodies like Beyond Blue, have raised the profile of a topic that has typically been hidden behind closed doors.

This community based and media driven conversation has been linked directly to debates about what constitutes effective recognition of and support for employees in the Australian workplace. As an example, media analysis, and in some cases court cases revolving around the plight of veterans or police members, have sharpened our focus on the place of well-being in the



Teams work in settings that can present risks to their safety; both physical and mental. Good communication, training, respect and experience play a significant role in mitigating the effects of critical incident stress © Anthony English

workplace more broadly (see for example ABC News, 2017a and b).

Perhaps most significantly, agencies in Victoria have for many years been governed by the Occupational Health and Safety Act 2004 (Vic) that defines ‘health’ as encompassing psychological health. The implications of this for employers has taken some time to eventuate, or to shape policy and practice. This legal foundation is nevertheless in place, and this, as well as growing acceptance by staff and the agency of the importance of mental health, will continue to generate change.

Parks Victoria’s successful focus in the last few years on what it terms a ‘Safety First’ culture that has looked at physical injuries and risks, has assisted employees to extend their conversations to include mental well-being by making safety conversations more frequent and accepted in the workplace. Ironically, the virtual absence of formal recognition of mental health and well-being throughout the evolution of the Safety-First programme has played a role in prompting more staff to

question why it is not considered more strategically in our workplace.

ACTIONS FOR CONSIDERATION BY PARKS VICTORIA

Several actions are suggested here to strengthen Parks Victoria’s ability to manage and prevent stress generated by traumatic and critical incidents. Some of the actions are high level and strategic, and others are more tactical and require a strategic context to be developed and implemented. Their relevance to Parks Victoria is strengthened by the fact that as an agency it has started to explore more strategically how mental health and well-being can be supported through its approach to workforce planning and management.

A fundamental first step would be for park agencies like Parks Victoria to express formal acknowledgement at whole of organisation level that exposure to trauma and critical incidents occurs, and can occur regularly in a range of settings. Taking this step would underpin any ensuing workforce management actions or directions.

Not only would acknowledgement provide an opportunity to also thank staff for their service, it would have a significant positive effect on staff resilience and well-being. Recognition would validate not only the lived experience of staff, but also the range of feelings or responses they encounter during and after these events. Gordon (2006) emphasises that to enable individuals and communities to recover from disaster, people need to feel safe, have their experience acknowledged, and access both social and psychological support. Recognition of the presence of trauma in the workplace at Parks Victoria, and of the form and frequency that it can take, would be a critical first step in creating an environment where staff feel safe and supported.

Flowing from this high-level step are a myriad of potential tactical actions. These can be grouped under several headings.

Data management and use

We have seen that data relating to incidents involving staff exposure to trauma needs significant redesign. Not only should Incident Report (IR) data support analysis of incident trends, it should also assist managers and staff to record and track employee involvement in incident response. Data could also be used to map locations where incidents occur and how frequently. Importantly, IRs themselves should be reflected in agency OH&S reporting systems so that staff exposure to incidents, potentially rated for their severity, can be made visible and a structured approach to talking with those staff members about their well-being can be initiated.

Workforce planning and management

Many of the actions below are predicated on the idea of developing staff member resilience, and enhancing their capacity to recover from or manage their exposure to trauma. This approach underpins the direction of the US Forest Service (2014) and reflects some of the core findings of the Western Australian Parliamentary Committee review (2012).

Critical workforce planning actions at Parks Victoria could include:

- Ensuring that staff induction includes effective messages and guidance about the potential to be exposed to significant or critical incidents. At present, new staff are sent into the workplace with very little awareness of this potential;
- Investing in developing pre-event resilience across the workforce through greater use of peer support and Psychological First Aid training;

- Expanding the concept of leadership and leadership training to encompass effectively supporting and managing the welfare of teams and not just their performance; and
- Active analysis of trends in the type and frequency of events in individual parks and the development of specific training, management and peer support for staff at those locations. As an example, there are parks that have tended to witness higher levels of suicide or significant accidents than others. This can be driven by an array of factors such as proximity to population centres, or the nature of recreational uses occurring there.

Policy and procedures

One of the notable dichotomies in current operational policy and procedure is that there is a plethora of training and guidance relating to responding to wildfires, but very little formal procedure that guides park agency staff response to other more frequent and potentially critical incidents such as suicides or accidents involving death or serious injury.

Again, this reflects the historical emphasis on fire as being the core of park agency emergency response. While the Victorian Emergency Management Manual (State Government of Victoria, 2017) sets out agency roles at different types of key incidents such as fires, this has not triggered the development of response procedures for many of the other incident types discussed here. Instead in Parks Victoria there has tended to be a reliance on locally developed approaches that have no formal standing. As an example, staff members may be advised by their managers that there is no obligation on them to go up to and look inside a vehicle in a park that looks suspicious and which may be the scene of a suicide. They may be directed that while they can choose to do so, it is equally appropriate for them to simply contact police or ambulance staff to attend the scene. This approach however is not enshrined in policy or procedure and team culture tends to lead most staff to actively investigate vehicles or other potential incident sites.

The reality is that operational field staff such as field service officers, rangers and seasonal fire fighters will often be the first to encounter or respond to a significant incident in a park, even if the ultimate responsibility for its management lies with another agency such as the police. Mapping out this reality and exploring whether staff are going beyond what they are required, trained and equipped to do, needs to occur. Park agencies need to confront the question of how they should train and

support staff to prepare for the events that will inevitably occur in the workplace. Overarching systems and incident response procedures also need to be established that are built on the premise of limiting staff exposure to trauma.

Looking outwards and learning

It is also very clear that the topics of CIS, stress and resilience have received a great deal of attention in settings outside park management. Recognition of the reality of significant incidents in the workplace by park agencies should trigger them to engage the expertise of those in the health, research and emergency services sectors to share their learning. This should not be a case of a park agency thinking that establishing a few new training courses, or key messages, will effectively address the challenge its employees face in the field. Adopting a strategic, adaptive and evolving approach that reflects best practice elsewhere needs to be the goal.

The importance of organisational culture and resilience

Finally, underpinning all this needs to be acceptance that only strong, resilient and connected organisations can effectively prepare and support teams involved in managing significant or critical incidents. A resilient organisation can be defined as one that is aware of and recognises threats, is able to predict and plan for disruption, supports staff to recover from significant events, and builds a collective sense of purpose (Parsons, 2010). These organisations possess positive leaders who enable devolved decision making, but also provide stability to the workforce. Without these characteristics, I argue that tools like EAP and training that may be put in place to manage CIS and exposure to trauma may become mechanistic, and not connected in any way to a meaningful relationship between employees and their manager or agency. It is for this reason that recognition by the agency of the occurrence of incidents in the workplace is so critical. Recognition is based on awareness and from this should flow action.

Tools and approaches need to resonate with staff and have meaning and validity in an operational team setting. Peer support processes that rely on active operational staff providing that service have been deemed successful because the affected staff feel that they are talking to someone who understands their experience. Successful peer support systems are therefore a good indicator that an organisation is indeed resilient. Parks Victoria would benefit from strengthening its currently small peer support programme, but it also needs to do so in the context of a

strategic plan that addresses stress in the workplace holistically.

I would extend this by arguing that a resilient organisation is one that embodies many of the elements that researchers argue create resilient communities. The concept of community resilience has been a significant area of investigation in recent years. The objective of creating resilience that enables communities to plan for and recover from significant incidents now underpins core emergency management policy such as the Safer Together programme in Victoria (State Government of Victoria, 2015).

Some of the principal elements that typify resilient communities according to Maguire and Hagan (2007) are their capacity to embody resistance to disruption, a capacity to recover and return to normalcy, and an ability to be creative and learn from experience in a way that further builds resistance. We need to explore how relevant these characteristics are to the goal of building resilient organisations. Maguire and Hagan emphasise the important role played by naturally emergent social resilience, exemplified by people pulling together after an event to support each other (2007, p.19). While this inherent capacity can be overwhelmed, they argue that it is a foundation that governments should build upon. Park agencies can look to the inherent connectedness of their teams in the same way.

CONCLUSION

In conclusion, staff in park management agencies have significant potential to be exposed to trauma and critical incidents of many different types in the workplace. Park agencies need to assess whether the language, leadership styles and culture they use supports or opposes the development of staff resilience. Many park agencies in Australia have undergone significant and, at times, protracted restructures in recent years. While change can and does bring significant innovation and new approaches, it can also have an impact on morale, and by extension the capacity of staff to manage their exposure to critical incidents.

Other underlying changes in workforce characteristics that may affect the development of resilience or connectedness need to be considered. One is the loss of field skills and experience that is occurring when staff retire or leave what is now, in places like Parks Victoria, an ageing workforce. The other is the increasing potential for senior leaders in park agencies to have had no exposure themselves to park operations at the field level. While not inherently problematic, where this is the case an agency should be looking critically at itself to

determine what type of leadership capability it needs, and at which levels, to develop an organisation that is connected across both the corporate and field-based elements of its structure.

Change will also be part of the solution. Importantly, it has been argued that the development of a gender balance in emergency management organisations and the influx of younger people will prompt employers and employees to develop more effective and mature approaches to preparing for and managing workforces that can experience trauma when conducting their duties (Parliament of Western Australia, 2012).

While there is much to be done, agencies like Parks Victoria are revealing a willingness and capability to tackle the challenge of staff exposure to critical incidents. Our goal should be to ensure that any staff members who may experience trauma in the workplace because of their duties should be supported to develop resilience ahead of such experience and supported effectively after exposure has occurred. While the needs and responses of individuals will vary widely, this should not detract from committing to such an organisational objective.

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ABOUT THE AUTHOR

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RESUMEN

El personal a cargo de la gestión de los parques responde periódicamente a incidentes en los parques que pueden llevarlos a experimentar o presenciar un hecho traumático. Estos incidentes incluyen asaltos, suicidios, comportamiento antisocial, operaciones de búsqueda y rescate, incendios forestales y muertes y lesiones graves causadas por accidentes. La exposición puede generar lo que se conoce como estrés postraumático. El personal suele ser el que primero reacciona ante muchos de estos incidentes, pero por regla general sus agencias no consideran que desempeñan funciones propias de los servicios de emergencia, excepto cuando se les encomienda responder a un incendio o una inundación. Este artículo examina cómo una agencia, Parks Victoria, ha abordado la exposición del personal a sucesos traumáticos. Arguye que históricamente el enfoque se ha centrado en la gestión y prevención de lesiones físicas en el lugar de trabajo, tendiendo a limitar el reconocimiento de los impactos del estrés en el personal a los incidentes relacionados con desastres naturales como los incendios forestales. Se sugieren y exploran diversas acciones estratégicas para abordar esta deficiencia. La discusión es relevante para otras entidades de gestión de parques y refleja la experiencia del autor en la gestión de parques en diferentes partes de Australia en los últimos veinticinco años.

RÉSUMÉ

Le personnel de gestion des parcs doit répondre régulièrement à des incidents susceptibles de les amener à subir ou à être témoin de traumatismes. Ces incidents comprennent des agressions, des suicides, des comportements antisociaux, des opérations de recherche et de sauvetage, des incendies de forêt ainsi que des décès et des blessures graves causés par des accidents. Cette expérience peut générer un stress post-traumatique connu sous le terme de «Critical Incident Stress». Les membres du personnel agissent souvent en tant que premiers intervenants dans un grand nombre de ces incidents, mais sont rarement perçus par leur direction comme exerçant des fonctions de service d'urgence, sauf lorsqu'ils sont chargés de mener des actions d'intervention contre le feu ou des inondations. Cet article explore comment une agence, Parks Victoria, a abordé la question de l'exposition du personnel aux traumatismes. Il met en lumière le fait que, historiquement, la priorité est centrée sur la gestion et la prévention de blessures physiques sur le lieu de travail, avec une tendance à minimiser la prise en compte du stress encourru à la suite d'incidents liés aux catastrophes naturelles telles que les incendies. De nombreuses actions stratégiques pour remédier à ce manque sont suggérées et explorées. Cet exposé peut présenter un intérêt pour d'autres organes d'administration de parcs et reflète l'expérience de l'auteur qui a travaillé dans la gestion de divers parcs à travers l'Australie au cours des vingt-cinq dernières années.



LARGE-SCALE EXPANSION OF MARINE PROTECTED AREA NETWORKS: LESSONS FROM AUSTRALIA

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ABSTRACT

Australia was one of the first countries to declare a marine protected area (MPA) in 1879, but it was not until the 1960s and 1970s, in efforts to protect the Great Barrier Reef, that marine protection was considered in a concerted way. The more recent development of MPA networks (or systems) by governments in state, territory and national (Commonwealth) jurisdictional waters has again placed Australia in the global spotlight in MPA development. We assembled the experiences of MPA representatives from government agencies, non-government organisations, academia and industry (in the form of commissioned written book chapters) to describe various aspects of MPAs in Australia, from the history, successes and challenges in creating jurisdictional networks, to the science, economics and legal aspects of Australian MPA networks, to different sectoral perspectives. Key themes are discussed and include: 1) Marine protected areas are always contested (at first), 2) Jurisdiction-wide network declaration versus single MPA declarations, each have pros and cons, 3) For federal systems of government, coordination between the jurisdictions is important, 4) Fishery reserves as the first MPAs 'muddy the waters' for the objectives of modern MPAs, 5) A multitude of categories and zones and uses has also confused the MPA concept, 6) Multi-use versus no take: proving the benefits and the need for clear targets for each type, 7) Acknowledging the gap between pure science and realpolitik in the placement of MPAs, 8) Involvement of Indigenous communities in MPAs has been slower than for terrestrial protected areas but improving. The recent and substantial changes to the Australian Government's historic 2012 declaration of a network of MPAs across its exclusive economic zone are also discussed.

Key words: marine protected areas, marine parks, protected area networks, zoning, marine conservation, land use allocation

INTRODUCTION

Australia was among the first countries in the world to establish a national park on land, with the Royal National Park near Sydney declared in 1879. Less well known is that the Royal National Park included an area of intertidal and close inshore marine areas, constituting what could be the oldest marine protected area (MPA) (in the modern sense) in the world (Brown, 2002), noting that there were traditionally managed marine areas managed for conservation in other parts of the world pre-dating this.

Although the national park network (or system) grew in popularity on land and expanded progressively since that early declaration, it was not until the late 1960s and early 1970s when there were proposals to drill for oil on the Great Barrier Reef that serious attention was paid to establishing protected areas in marine waters in Australia. The declaration of the Great Barrier Reef

Marine Park in 1975 drew international attention to Australia at the time. The more recent development of MPA networks¹ by governments in state, territory and national (Commonwealth) jurisdictional waters has again placed Australia in the global spotlight in MPA development.

Australia is an island continent with an ocean territory that is the third largest on Earth and Australians are mostly coastal dwellers – 85 per cent of Australians live within 50 km of the coast (Trewin, 2004). Today, Australia has more than 327,790,000 ha of sea declared as MPAs, comprising almost 36 per cent of its waters. This represents a nearly five-fold expansion from 7.1 per cent in 2002 (Taylor et al., 2014). The global coverage of MPAs in late 2014 was 3.4 per cent of waters reserved (Spalding & Hale, 2016; up from 1.6 per cent in 2010, Tratham et al., 2012). Marine national parks and other highly protected areas (IUCN Categories I–III) grew

nearly seven-fold, to cover from 2 per cent to 13.5 per cent of Australian waters, up to 2014 (Taylor et al., 2014) (Figure 1 – but see ‘Recent developments’ section below).

Like the approach on land, the development of MPA networks in Australia has, over the past two decades, been guided by the principles of comprehensiveness, adequacy and representativeness, using bioregions as a basis to guide priorities (ANZECC TFMPA, 1998; Commonwealth of Australia, 2006; Australian Government, 2007). As a federated nation, the six state governments and the Northern Territory generally have responsibility for waters within 3 nautical miles of the coast and the (federal) Australian Government for waters beyond 3 nautical miles within Australia’s Exclusive Economic Zone. Thus, separate MPA networks have been created for each of these jurisdictions under different approaches, policies and legislation, but with the more recent aim of a more consistent and uniform approach to MPA network principles.

However, the establishment of MPAs has not been without controversy and, in some cases, a decline in political support. Despite the significant activity, discussion and debate around MPAs in Australia, there have been few attempts to bring together the history, current status and future directions of each of the Australian MPA networks (national, territory and state) or to align different perspectives from the various sectors on MPA concepts more broadly. To fill this void, a recent project has assembled the experiences (in the form of commissioned chapters for a book, *Big, Bold and Blue: Lessons from Australia’s Marine Protected Areas* (Fitzsimons & Wescott, 2016), of MPA representatives from government agencies, non-government organisations, academia and industry to describe various aspects of MPA networks in Australia. These experts were chosen by the authors based on their strong knowledge of the particular topic relating to MPA networks (e.g. Indigenous involvement, legal frameworks, etc.) and/or involvement in creating MPA networks in different jurisdictions, and they were asked to write to predefined chapter templates. This book covered from the history, successes and challenges in creating jurisdictional networks (in states and Northern Territory coastal waters within 3 nautical miles and in Australian Government-controlled waters – Australia’s Exclusive Economic Zone beyond 3 nautical miles, the Great Barrier Reef and Australia’s Antarctic and sub-Antarctic waters), to the science, economics and legal aspects of Australian MPA networks to different

sectoral perspectives (Fitzsimons & Wescott, 2016). The findings from these chapters are synthesised in this paper based on the common themes raised.

As most countries around the world seek to build their MPA networks in response to commitments they have made under the Convention on Biological Diversity, the lessons from Australia are likely to be even more timely. Past compilations of differing perspectives of MPA development and implementation have either been at a more general level (e.g. Claudet, 2011; Day et al., 2015) or are not particularly recent (e.g. Beumer et al., 2003). This paper seeks out common lessons, both positive and negative, acquired from the Australian experience during the recent rapid expansion of MPAs, particularly over the past two decades.

KEY THEMES

There were a number of clearly recurring themes and lessons that emerged from the analysis of lessons for creating MPA networks in Australia, as well as points of difference. These are described under separate headings below.

Marine protected areas are always contested (at first)

In almost all Australian jurisdictions, and particularly in the last two decades, the establishment of MPAs, either singly or as part of networks, has been contested, especially where this has placed restrictions on fishing or other extractive industries (e.g. Wilson, 2016; Thomas & Hughes, 2016; Wescott, 2016; Clarke, 2016; Edyvane & Blanch, 2016; Meder, 2016). This contestation is reflected in other countries as well (e.g. Spalding & Hale, 2016). In Australia, for example, approximately 740,000 submissions were received in the public consultation periods process for the establishment of the Commonwealth Marine Reserve networks and related management plans (prior to their review in 2017) (see also Wescott & Fitzsimons, 2011). The majority of these were campaign submissions (both for and against the marine reserve networks proposals; Cochrane, 2016; Smyth, 2016). This contestation involved non-coastal waters that most Australians have never seen, or are likely to ever visit. The subsequent review of the reserve network (and further rounds of public consultation) was prompted by the considerable pressure from user groups, with the appointment of two “expert panels [to] help restore confidence in Commonwealth marine reserves” by providing “advice to the [Australian] Government, based on the best available science and after genuine consultation with stakeholders” (Hunt & Colbeck, 2014).

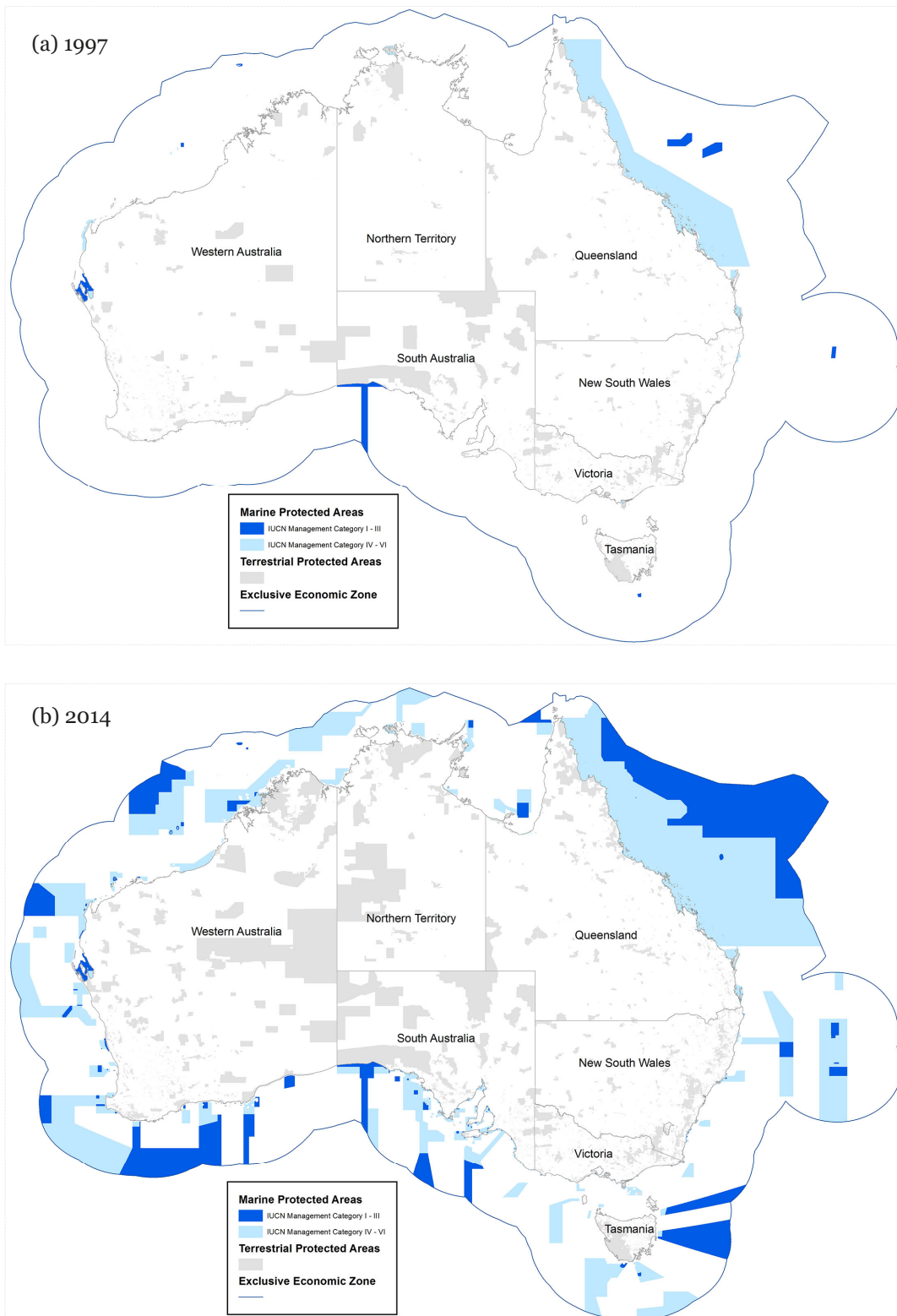


Figure 1. Australia's Marine Protected Area estate in a) 1997 and b) 2014. External waters of Heard and McDonald Islands, Macquarie Island, Norfolk Island, Christmas Island and Cocos (Keeling) Islands not shown. Note changes to some zones occurred post 2014 (see Figure 7c). Source: Collaborative Australian Protected Areas Database Marine 2014 (Department of the Environment, 2014)

This resistance has been driven by fishing groups in particular, despite apparent strong public support for MPAs in principle (Meder, 2016). Strong fishing lobbies are considered the reason for the lack of concerted establishment of networks of MPAs in Tasmania and the Northern Territory (Edyvane & Blanch, 2016).

However, experience in other states suggests that this early discontent and negative reactions from fishers and some locals mostly changes to neutral or positive perceptions over 5–10 years after an MPA is established (e.g. Western Australia [Wilson, 2016], New South Wales [Clarke, 2016], Great Barrier Reef [Day, 2016]). Despite this, there have been campaigns by the fishing lobby in some states for an opening up of strict MPAs (Clarke, 2016; Wescott, 2016). This pressure to actually reverse reservation decisions, although relatively unknown in terrestrial protected area systems in Australia, seems to be more common in the marine environment.

Jurisdiction-wide network declaration versus single MPA declarations, each have pros and cons

MPAs in Australian jurisdictions have varied in the way they have been created. These differences in establishment are reflected in legislation, which falls into three main categories: specific MPA legislation, fisheries legislation and general national parks legislation (Techera, 2016).

In most jurisdictions, early MPA declarations were a 'one off', typically protecting a small area of particular interest. The advent of the large, multi-zoned Great Barrier Reef Marine Park with its own legislation, and particularly the 2003 rezoning, heralded the beginning of considering the entire extent of a large portion of Australian waters for MPA network designation at the same time. Victoria was actually the first Australian jurisdiction to systematically consider its entire marine waters for the establishment of a comprehensive, adequate and representative MPA network, declared in 2002. South Australia, the Commonwealth Regional Marine Planning processes and the Antarctic MPA proposals being considered by the Commission for the Conservation of Antarctic Marine Living Resources are other examples of MPA networks created from processes considering the entire jurisdiction at one time. Some states, such as Western Australia and Tasmania, have undertaken systematic reviews and declarations for parts of their jurisdiction (the Kimberley in Western Australia; and southeast Tasmania), whereas New South Wales and Queensland have implemented relatively large zoned MPAs in

various parts of their jurisdiction but have not assessed all of their waters for this purpose. The Northern Territory (with only two marine parks) seems to be the furthest from developing a comprehensive, adequate and representative MPA network (Edyvane & Blanch, 2016).

Establishing an MPA network based on considering the entire jurisdiction (or a large proportion of it) at once has several advantages, including (i) the consideration of the comprehensiveness, adequacy and representativeness of their MPA estate with consistent ecological data and the ability to adjust boundaries to accommodate other uses, (ii) a dedicated process with public consultations and public submissions (see also Wescott, 2006; Coffey et al., 2011). Disadvantages include a potential inability to campaign and make a good case for MPAs over the entire jurisdiction by MPA advocates due to lack of resources or limited public attention (particularly if the region is large) (Smyth, 2016), or claims that resource use stakeholders have not been properly consulted or have become 'drained' by the process (Boag, 2016).

For federal systems of government, coordination between jurisdictions is important

As with many federal nations, Australia divides control over its marine environment between a federal (national) government and governments of states and territories. The result in Australia is that coastal waters (accessible to many recreational and commercial uses by ordinary citizens) come under the state/territory government's control while waters beyond the 3 nautical mile limit (which have more industrial uses and require significant infrastructure and resources to be exploited), in general, come under national government control.

In realpolitik terms, this means that state and territory governments will bear the brunt of any anger and disputes over the loss of access to a previously available resource (e.g. fish) while the national government will see far less pressure from voting members of their electorates.

This results in far more disputation directed at the more poorly resourced state/territory level and hence greater difficulty for state and territory governments in implementing MPAs in Australia. It also means that it can take considerably longer to establish a network of MPAs in coastal waters (see Edyvane & Blanch, 2016; Thomas & Hughes, 2016; Wescott, 2016), where their need is higher because of greater human use impacts, than in national offshore waters (Beaver, 2016).

This would appear to be an argument for the national government to directly (i.e. financially) assist the states in establishing their MPA networks if Australia is to establish a genuine comprehensive, adequate and representative MPA network that considers all the nation's waters.

Fishery reserves as the first MPAs 'muddy the waters' for the objectives of modern MPAs

In most Australian jurisdictions, either the first area-based protection mechanisms covering marine areas were specifically declared to protect fish resources (e.g. nursery grounds, or temporary closures of fisheries to prevent over-fishing); or fishery regulations were used to establish MPAs for biodiversity conservation reasons (perhaps because other legislative/regulatory processes were not available, at the time, for reservation in the sea) (e.g. Harold Holt Reserve in Victoria).

This historical legacy may well be the reason for the continued perception by some, such as those in fishery circles, that MPAs are fishery management tools rather than biodiversity conservation tools (Boag, 2016; Goldsworthy et al., 2016; Wilson, 2016).

This confusion has led to significant heat in the debate about the location of individual MPAs and broader MPA networks, with those from a fishery perspective often debating the need for an MPA in a particular location based on its value for fishery management (Goldsworthy et al., 2016; Wilson, 2016). This in turn creates 'heat' in politicians' and senior decision makers' minds as well – particularly if they see conservation in terms of the sustainable use of natural resources rather than including nature conservation for the intrinsic value of the nature itself (e.g. Taylor, 2013).

Some jurisdictions do have some element of their MPA networks focused on fishery management and this may complicate the understanding of the purpose of MPAs more generally. For example, Queensland's network of Fish Habitat Areas (declared under the *Fisheries Regulation 2008*) consists of 70 declared areas covering more than 1 million ha and is spread across the state, complementing larger, zoned MPAs declared under the *Marine Parks Act 2004* (Ogilvie, 2016). In addition, conservation groups do promote MPAs as a means to prevent overfishing (Boag, 2016; Sheridan, 2016; Smyth, 2016) and it may be that the public also perceive MPAs for that purpose, at least in part (Sheridan, 2016).

This may be a communication problem rather than an institutional one and if the nomenclature system for MPAs and broader sea use classification system (e.g.

Smyth & Wescott, 2016) more clearly separated out the reasons for a specific reservation (e.g. biodiversity conservation, temporary fishery grounds closure, habitat protection for breeding stock, etc.) an area of conflict might be substantially reduced (see also Day et al., 2018 for international IUCN guidance on this).

A multitude of categories and zones and uses has also confused the MPA concept

There are more than 30 different named designations given to MPAs in Australia (e.g. marine parks, marine national parks, marine sanctuaries, etc.). Even where a designation has the same name in multiple jurisdictions (e.g. 'marine park') they might have quite different allowable activities (e.g. New South Wales, Great Barrier Reef, South Australia: Clarke, 2016; Day, 2016; Thomas & Hughes, 2016). This potentially adds to the confusion among the public about what MPAs are and what they are trying to achieve (which is a global problem the IUCN has sought to address through the *Guidelines for Applying the IUCN Protected Area Management Categories to Marine Protected Areas* – Day et al., 2018). It is likely the concept of a 'national park' or 'nature reserve' on land has much greater community understanding of purpose and allowable activities.

There are two general models followed by jurisdictions in Australia for MPAs. One is the zoned MPA model where generally larger MPAs have a variety of legal zones within their outer boundaries, which typically include a mix of high protection (no-take) zones, semi-restrictive zones and zones that are very lightly restrictive of some extractive uses, such as recreation and commercial fishing (Figure 2). The benefits of such an approach (i.e. multiple use in MPAs) is that a greater



Figure 2. Batemans Marine Park in New South Wales, Australia with multiple zones © James Fitzsimons

variety of users can access and appreciate an MPA, including those that are in many cases (initially) opposed to MPAs. Conversely, having such a diversity of activities within a single protected area can make it hard for the public, who are not regular users, to determine an ‘identity’, or specific purpose, for such a sea use. This zoning approach is adopted in Queensland, New South Wales, South Australia, the Great Barrier Reef Marine Park and some of the Commonwealth Marine Reserves.

The historical use of the term ‘marine park’ to describe what was in reality a spatial zoning system with a majority of areas designated for ‘general use’ (i.e. containing few restrictions for the entire Great Barrier Reef Marine Park) certainly confused the public in other jurisdictions in Australia (and perhaps globally) and may well have made it harder to convince the community of the value of MPAs (see Wescott, 2006).

The other model is the non-zoned approach such as Victoria’s no-take system of marine national parks and marine sanctuaries (Wescott, 2016) (Figure 3), and the multi-use but not-zoned MPAs (where certain activities are regulated) in the Northern Territory (Edyvane & Blanch, 2016) and some Tasmanian reserves (Kriwoken, 2016). The benefit of this approach is a clear articulation of the purpose of the reserve or the network (see Wescott, 2006), although these areas are typically smaller and potentially engage fewer users.

The Commonwealth Government, Western Australia and Tasmania have MPAs that are both zoned and not zoned (Cochrane, 2016; Kriwoken, 2016; Wilson, 2016). The proposed East Antarctic Representative System of Marine Protected Areas is based on a ‘multiple use’ approach, where research and exploratory fishing activities would be allowed when they are judged consistent with the maintenance of the objectives of the MPAs and considered sustainable under existing conservation measures (Goldsworthy et al., 2016).

Multi-use versus no take: proving the benefits and the need for clear targets for each type

Much emphasis in the development of MPA networks by scientists and conservationists focuses on the establishment of strict protection MPAs, particularly no-take zones (Kenchington, 2016; Smyth, 2016; Ward & Stewart, 2016). This in part may be due to the historic prevalence of multi-use MPAs (e.g. Costello & Ballantine, 2015) and the clearer ecological benefits of MPAs where there is less human exploitation (e.g. Edgar et al., 2014). There is a current lack of international criteria, or guidance, on the mix of no-



Figure 3. Churchill Island Marine National Park, Victoria, Australia. One of three, non-zoned marine national parks in Western Port that are strict no-take MPAs © James Fitzsimons

take and multi-use in targets such as the 10 per cent Aichi Target 11 of the Convention on Biological Diversity. However, there are moves from other international forums to be more explicit. For example, the final declaration of the 2014 World Parks Congress called for bolder targets – “at least 30 per cent of each habitat type to be afforded strict protection” (although this is not binding), while the 2016 World Conservation Congress supported a motion to encourage IUCN State and Government Agency Members to designate and implement at least 30 per cent of each marine habitat in a network of highly protected MPAs by 2030 (motion #53; <https://portals.iucn.org/congress/motion/053>).

In Australia, the 1998 *Guidelines for Establishing the National Representative System of Marine Protected Areas* pre-dates these international agreements and is silent on percentage targets, but states “NRSMPA will aim to include some highly protected areas (IUCN Categories I and II) in each bioregion” (ANZECC TFMMPA, 1998; although, somewhat confusingly, this does not always equate to ‘no take’, see Fitzsimons, 2011). Updating Australia’s national policy to better recognise area/percent-based targets while honouring the existing national commitments to bioregional representation in highly protected MPAs should be a priority.

Acknowledging the gap between pure science versus realpolitik in the placement of MPAs

The principles of comprehensiveness, adequacy and representativeness guide the establishment of MPA networks in Australian jurisdictions and it is the stated

wish that the full range of habitats are included in Australia's MPA network (ANZECC TFMPA, 1998).

The Aichi targets of the Convention on Biological Diversity have included the need for connectivity and consideration of ecosystem services in addition to the representation of habitats. Globally, MPA coverage appears to show some level of inverse correlation with coastal population densities, despite many ecosystem services being tightly linked to local human populations who receive direct benefits from coastal protection, food provision, tourism income, etc. (Spalding & Hale, 2016). Nonetheless, ecosystem services and other socio-economic benefits have been demonstrated for several Australian MPAs (Marshall, 2015; Hoisington, 2016) (Figure 4).

Different groups of people have quite different perspectives on the reasons for declaring MPAs, the methodology and decision-making processes for deciding where to place these MPAs and the various restrictions on use within different categories of MPAs. In particular, there seems to be one most overt dichotomy: the difference between the belief among some that the scientific data should solely determine, or

at least be the primary determiner of (e.g. Devillers et al., 2015), MPA location and extent, and the recognition by interested parties from many different sectors that a range of factors (historical and future uses, social acceptability, etc.) need to be considered in the placement of MPAs.

In the end it is a political decision to determine how, where and when a system of MPAs is to be established for biodiversity conservation purposes, and how this is balanced with other legitimate uses of the sea. Although such decisions are difficult at the best of times (there are going to be clear winners and losers), bipartisan support is usually required to see the declaration of MPAs through a parliament of the relevant jurisdiction. This usually involves some compromises in locations and uses (e.g. Cochrane, 2016; Clarke, 2016; Day, 2016; Wescott, 2016).

If there is not bipartisan, or multi-partisan, political support, then a second level of politics occurs – alternatives are offered up to the electorate complete with electoral tactics of marketing and misleading information. This has certainly occurred in Australia in recent years and, while science is predominantly used to



Figure 4. Great Barrier Reef Coast Marine Park at Cape Tribulation, Queensland, Australia protecting ecosystem services such as shoreline protection © James Fitzsimons

justify the establishment of MPA networks, it is naïve to think science alone will overcome party electoral rhetoric (see ‘Recent developments’ section below).

Involvement of Indigenous communities in MPAs has been slower than for terrestrial protected areas, but improving

Much like the slower development of protected areas in the marine realm compared with the terrestrial realm, recognition of Indigenous rights, ownership and access to sea country has been slower than on land. But this is changing. Legal recognition in the Torres Strait, the intertidal zones of the Northern Territory and various other jurisdictions is seeing greater Indigenous involvement in formal management arrangements, including MPAs (Smyth & Isherwood, 2016).

The current lack of inclusion of Indigenous Protected Areas (IPAs) in marine environments when accounting for progress towards national conservation targets (such as the National Representative System of Marine Protected Areas: ANZECC TFMPA, 1998; Rose, 2012) is inconsistent with the treatment of IPAs on land (where IPAs are considered part of the terrestrial National Reserve System). With the number of sea country IPAs likely to increase, including over existing MPAs such as the Great Barrier Reef Marine Park and Commonwealth Marine Reserves, this policy position seems antiquated and in need of updating (see also Smyth et al., 2016).

FUTURE DIRECTIONS FOR RESEARCH AND POLICY FOR MPAS IN AUSTRALIA

One of the striking contradictions in the attempt to increase MPAs is the outcome of public polling and surveys that suggest strong general community support for declaring protected areas in the marine environment (Meder, 2016; Sheridan, 2016) juxtaposed to the strident public opposition from other interests. Apparently, from the decision-makers’ point of view, the negativity towards declaring MPAs evidenced in the popular media (e.g. Compas et al., 2007) is not offset by the polling which suggests a majority of constituents want MPAs declared (Sheridan, 2016). Exploring the sociological element of the ‘MPA debate’ is a potentially fruitful and useful area for further research.

Clearer guidelines on which reservation targets are being applied are clearly needed at the national and international level (for example, in Australia, are they the ANZECC TFMPA (1998) national policy targets, the Convention on Biological Diversity’s Aichi Target 11 ‘10% in a representative, well connected network’, or the 2016 World Conservation Congress resolution of 30 per cent strict protection, or a combination of these?). The benefits provided by strict protection might be used to set a subsidiary target for no-take MPAs, to ensure the development of a network of sites delivering the highest possible value in terms of biological controls, fisheries enhancement and recreational value.



Figure 5. Twelve Apostles Marine National Park, Victoria, stretches to high-water mark, and adjoins (and overlaps with) the terrestrial Port Campbell National Park which extends to low-water mark © Dean Ingwersen



Figure 6. Macquarie Island Nature Reserve, Tasmania, includes both terrestrial and marine environments © Bob Zuur).

Considering international obligations under the Convention on Biological Diversity to meet spatial targets for protected areas on land and sea, the need for accurate geospatial data is critical for conservation planners and policy makers to assess progress. In developing summary statistics for MPAs in Australia, several significant errors were discovered within Australia's national protected area dataset relating to MPAs (i.e. the 2014 Collaborative Australian Protected Areas Database; Department of the Environment, 2014). These included counting the entire area of several mostly terrestrial protected areas in the marine figures and including most of the Victorian MPA network in the terrestrial geospatial dataset.

Although primarily terrestrial protected areas on the coast may include intertidal areas down to low-water mark (Figure 5), or estuaries, and some MPAs may extend to high-water mark, there are few examples of single protected areas that incorporate significant areas of both land and sea (although notable exceptions include Kent Group National Park and Macquarie Island Nature Reserve [Figure 6] in Tasmania and Nooramunga Marine and Coastal Park in Victoria). This has the impact of fragmenting management, particularly on the coastal fringe where use of an MPA is likely to be most exposed to public use and potential misunderstanding. Here, lessons for government institutions may be drawn from the use and

management of land and sea country by Indigenous Australians. Indigenous Australians do not see a rigid boundary between the sea and the land but a continuum of 'country', which reflects the ecology of the transition far better than rigid legalistic and cultural views of Western-based approaches. At the very least, stronger management of intertidal zones in primary terrestrial coastal MPAs (which occur in all Australian states and the Northern Territory) for their marine values should be considered.

The final observation is that a possible explanation for why it appears to have been so difficult to establish networks of MPAs around the globe may be that the development, understanding and support for marine protected areas lags a century behind terrestrial protected areas (see also Wells et al., 2016). Nonetheless, this 'gap' appears to be rapidly closing.

RECENT DEVELOPMENTS IN MARINE PROTECTED AREAS IN AUSTRALIA

The largest contribution in terms of area to Australia's MPA estate has come from networks of MPAs established in waters controlled by the Australian Government between 3 nautical miles from the coast to the edge of the exclusive economic zone. These MPA networks were established in 2007 and 2012 (Cochrane, 2016) (Figure 7a) and made Australia a world leader with its science-based, bioregional approach and public

consultation process. However, developments since that time, and since the analysis described earlier in the paper, which have seen reductions in high protection zones, have put this reputation, and Australia’s conservation of its marine environment, at risk. The developments are outlined below as both an update of the Australian MPA system and to highlight that despite seemingly widespread public support, changes to networks can occur for (partisan political) reasons that are not always made explicit.

Independent Review of Commonwealth Marine Reserves

In 2013, the incoming Australian conservative Coalition Government instigated an Independent Commonwealth Marine Reserves Review through two parallel processes – a review of the science underpinning Commonwealth Marine Reserve management by a five member Expert Scientific Panel, and stakeholder consultation at the national and regional level through the establishment of five Bioregional Advisory Panels. That review started in

September 2014 and was completed in December 2015. The review (which did not include the South-east network) recommended reductions to the size of highly protected zones in the Coral Sea but the addition of some high protection zones elsewhere, negotiating boundary changes to reduce the impact on the fishing sector while maintaining the scientific integrity of the system (Beeton et al., 2015; Buxton & Cochrane, 2015) (Figure 7b). Overall, while the review process recommended retaining the outer boundaries of Commonwealth Marine Reserves, it recommended altering some of the internal highly protected zones (reducing these to 33 per cent of the MPA area, slightly down from the 36 per cent in the 2012 declaration).

Draft Management Plans for Commonwealth Marine Reserves (Australian Marine Parks)

On 21 July 2017, the Australian Government Director of National Parks released draft management plans for Commonwealth Marine Reserves (Figure 7c, Table 1) (with a proposed name change to ‘Australian Marine

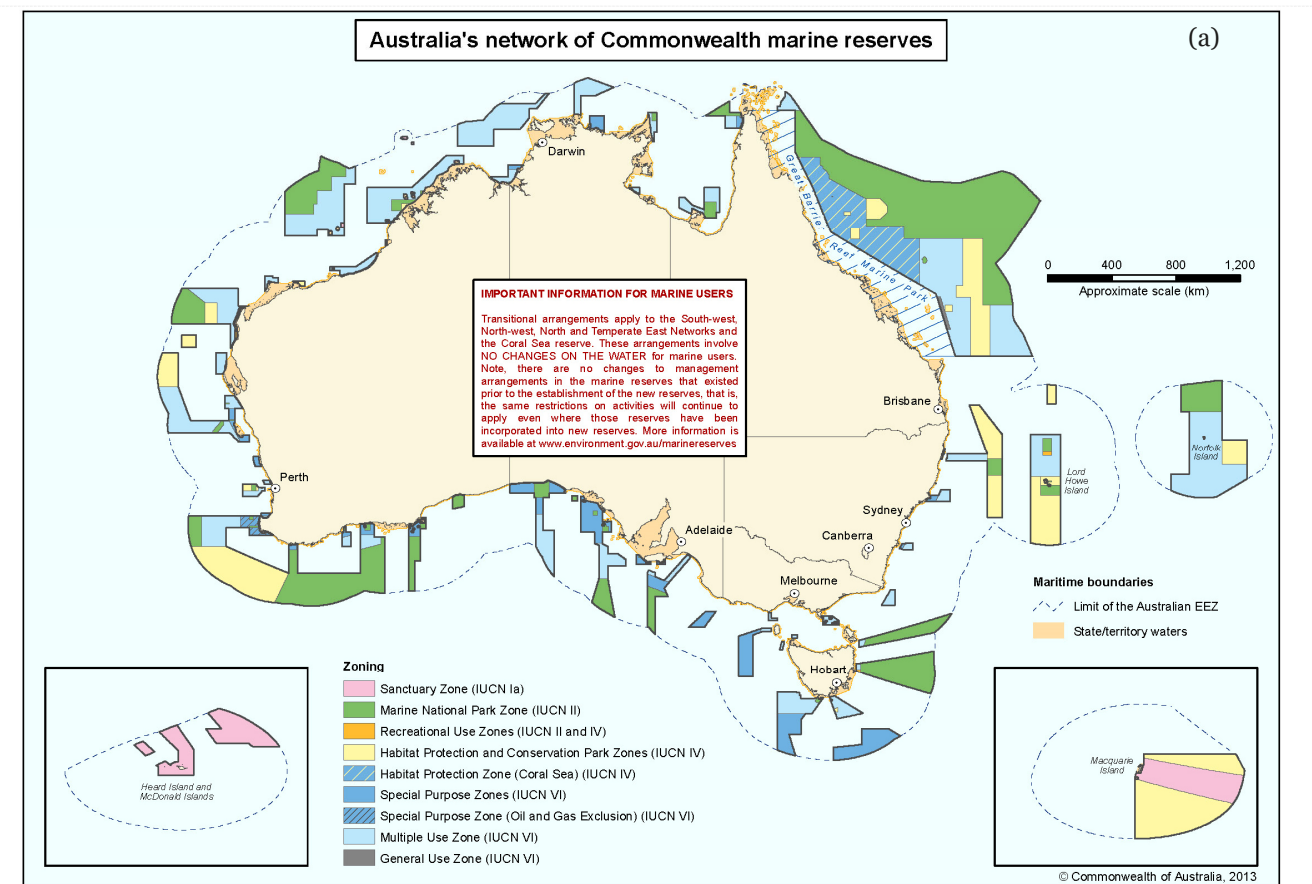


Figure 7 a) Commonwealth Marine Reserves and zoning at 2012 declaration of South-west, North-west, North, Temperate East and Coral Sea networks, b) Recommended rezoning of Independent Commonwealth Marine Reserves Review Bioregional Advisory Panel of these networks, c) Zoning proposed in 2017 Draft Management Plans (accepted by the Australian Parliament in 2018) Source: Australian Government.

Table 1. Summary of proposed changes to zoning of Commonwealth Marine Reserves from 2012 declaration to release of draft management plans (adapted from Director of National Parks, 2017)

Zone	At proclamation (2012)	Draft plans (July 2017)	Additional note
Green zones (high level of protection)	<ul style="list-style-type: none"> • 866,335 km² • 36% • 331 conservation features protected 	<ul style="list-style-type: none"> • 465,327 km² • 20% • 331 conservation features protected 	<ul style="list-style-type: none"> • Of 509 conservation features, such as canyons, seamounts and reefs, a total of 331 or 65% are protected under sanctuary or national park zones – the highest level of protection possible. • 63% of marine parks covered by green and yellow zones compared to 60% in 2012. • 63% of marine parks closed to oil and gas extraction, compared with 60% today.
Yellow zones (allows for sustainable use, so long as seafloor not harmed)	<ul style="list-style-type: none"> • 564,132 km² • 24% • 192 conservation features protected 	<ul style="list-style-type: none"> • 1,017,877 km² • 43% • 265 conservation features protected 	<ul style="list-style-type: none"> • Another 265 conservation features are protected under habitat protection zoning, protecting the seafloor.
Blue zones	<ul style="list-style-type: none"> • 944,253 km² • 40% 	<ul style="list-style-type: none"> • 891,250 km² • 37% 	<ul style="list-style-type: none"> • Allows for sustainable use.

Parks’) for the South-west, North-west, North, Coral Sea and Temperate East network. The draft management plans proposed to reduce the area of high level protection (‘green zones’) proposed in the 2012 proclamation from 36 per cent (and 33 per cent in the Review mentioned immediately above) to 20 per cent. The draft management plan zoning suggested that the same number (331) of conservation features were to be protected in green zones in the 2012 and draft management plans (Director of National Parks, 2017). While this seemed encouraging from a representation perspective, it is not clear how many conservation features were not represented. The nationally-agreed *Guidelines for Establishing the National Representative System of Marine Protected Areas* stated clearly “the NRSMPA will aim to include some highly protected areas (IUCN Categories I and II) in each bioregion” (ANZECC TFMPA, 1998). In the 2012 zoning, 17 of Australia’s 85 bioregions had no high-protection MPAs, and a further 22 had 1 per cent or less in high-protection MPAs (Beaver, 2016). Further reductions in the area of high protection are likely to impact this representation, while the significant reduction in green zone area is likely to impact the adequacy of the network.

In making the proposed changes, the Director of National Parks (2017) considered comments from “over

54,000 submissions providing feedback on the preparation of draft plans”, as well as “the recommendations from the independent review of Commonwealth marine reserves released in 2016; the best available science; the expertise of traditional owners on managing sea country; and experiences from those managing Australian and international marine parks”. Furthermore, the Director of National Parks (2017) stated “Our more balanced approach means there is a significant increase in yellow zones – where the seafloor is protected, but activities like diving and fishing are allowed. Our green zones are based on the best available science – while minimising impacts on our important tourism and fishing industries”. Despite this emphasis on ‘best available science’, no scientific analysis nor public consultation analysis was presented to justify the significant reduction in highly-protected zones (especially in the South-west and the Coral Sea) subsequent to the recommendations of the Independent Review process and the substantive process leading up to the 2012 declaration. WWF-Australia claimed “the Federal Government’s proposed changes to marine parks would be the largest downgrading of protected area the world has ever seen” (WWF-Australia, 2017).

The management plans passed both houses of Parliament in early 2018 and came into effect on 1 July 2018 (see <https://parksaustralia.gov.au/marine/>).

CONCLUSIONS

Guided by a science-based approach in the past two decades, the Australian MPA estate has grown rapidly but has faced (and continues to face) a number of challenges, many of them political. Some of the lessons from the Australian experience presented here may be applicable to other nations and states as they seek to build their MPA networks to meet international targets for marine conservation (e.g. Convention of Biological Diversity, especially Aichi Target 11 (CBD, 2010)).

ENDNOTES

¹A Marine Protected Area Network can be defined as “a collection of individual MPAs or reserves operating cooperatively and synergistically, at various spatial scales, and with a range of protection levels that are designed to meet objectives that a single reserve cannot achieve” (IUCN-WCPA, 2008).

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RESUMEN

Australia fue uno de los primeros países en declarar un área marina protegida (AMP) en 1879, pero no fue sino hasta las décadas de 1960 y 1970 que, con motivo de los esfuerzos emprendidos para proteger la Gran Barrera de Coral, la protección marina se consideró de forma concertada. El desarrollo más reciente de redes (o sistemas) de AMP por parte de los gobiernos en las aguas jurisdiccionales estatales, territoriales y nacionales (Commonwealth) ha situado a Australia nuevamente en el centro de atención mundial en el desarrollo de AMP. Recogimos las experiencias de representantes de AMP de organizaciones gubernamentales y no gubernamentales, de la industria y la academia (en forma de capítulos de libros escritos por encargo) para describir diversos aspectos de las AMP en Australia, desde la historia, los éxitos y los desafíos en la creación de redes jurisdiccionales, pasando por los aspectos científicos, económicos y legales de las redes australianas de AMP, hasta diferentes perspectivas sectoriales. Se examinan e incluyen temas clave como: 1) Las áreas marinas protegidas son siempre cuestionadas (al principio); 2) Declaración en relación con redes de AMP para todas las jurisdicciones frente a declaraciones de AMP individuales, con sus respectivas ventajas y desventajas; 3) Para los sistemas federales de gobierno, la coordinación entre jurisdicciones es importante; 4) Por ser las primeras AMP establecidas, las reservas pesqueras "enturbian las aguas" para los objetivos de las AMP modernas; 5) Un sinnúmero de categorías, zonas y usos también ha confundido el concepto de AMP; 6) Uso múltiple versus protección total: poniendo en evidencia los beneficios y la necesidad de objetivos claros para cada tipo; 7) Reconocer la brecha entre la ciencia pura y la realpolitik o pragmatismo político en el establecimiento de AMP; 8) La participación de las comunidades indígenas en las AMP ha sido más lenta que en las áreas protegidas terrestres, pero está mejorando. También se examinan los cambios recientes y sustanciales en la histórica declaración de 2012 del Gobierno australiano sobre una red de AMP en su zona económica exclusiva.

RÉSUMÉ

L'Australie a été l'un des premiers pays à installer une aire marine protégée (AMP) en 1879, mais ce n'est que dans les années 1960 et 1970, dans le cadre des efforts déployés pour protéger la Grande Barrière de Corail, que la protection marine a été envisagée de manière concertée. La création plus récente de réseaux d'AMP par des états, des territoires et des juridictions nationales (du Commonwealth) a de nouveau placé l'Australie au premier plan dans le développement des AMP. Nous avons rassemblé (sous forme d'écrits commandés pour un livre) les retours d'expérience de représentants des AMP, tels des universitaires, des industriels, des membres d'administrations ou d'ONG, afin de donner une présentation complète des AMP, en partant de de leur histoire, pour retracer ensuite les succès et les difficultés rencontrées lors de la création de réseaux juridictionnels, puis aborder les aspects scientifiques, économiques et juridiques, à partir des différentes perspectives sectorielles. Les thèmes clés abordés comprennent : 1) Les aires marines protégées se trouvent toujours contestées (du moins au début), 2) Les avantages et les inconvénients de la mise en place d'un réseau d'AMP à l'échelle d'une juridiction, par rapport à une AMP unique, 3) L'importance de coordination entre les juridictions dans un système de gouvernement fédéral, 4) Les réserves de pêche constituant les premiers exemples d'AMP ont 'brouillé les pistes' pour les AMP modernes dans réalisation de leur objectifs, 5) Le concept d'AMP s'est trouvé dilué par une multitude de catégories, de zones et d'utilisations, 6) Entre la protection totale et la gestion des activités : démontrer les bénéfices des différentes intensités de protection et la nécessité d'objectifs clairs pour chaque cas, 7) La reconnaissance de l'écart entre la science pure et la realpolitik dans l'installation des AMP, 8) L'implication des communautés autochtones a été plus lente dans les AMP que dans les aires terrestres protégées, mais est en progrès. Nous examinons également les importants changements récents apportés par le gouvernement australien à son décret historique de 2012 concernant la création du réseau d'AMP dans sa zone économique exclusive.



SPATIO-TEMPORAL ANALYSIS OF ILLEGAL ACTIVITIES FROM RANGER-COLLECTED DATA IN W NATIONAL PARK OF BENIN

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ABSTRACT

This study analyses the spatio-temporal trends of illegal activities in W Biosphere Reserve of Benin in order to provide guidance for planning the patrol system. We used ranger-collected data on illegal activities in the reserve from 2012 to 2015. Illegal grazing is the most common illegal activity observed in the reserve (1,137 incidents), followed by poaching (469 incidents), agricultural encroachment (285 incidents) and logging (69 incidents). The distribution of these activities in the reserve is highly dependent on zones and also varies between seasons. Generally, incidents of illegal activities were more frequent during the non-hunting season than the hunting season because of flooding, impassability of tracks and closing of plant cover which limit patrol activities during the non-hunting season. From these findings, managers of the W National Park can identify high human pressure zones where ranger patrol efforts should be enhanced. We propose the use of emerging technologies such as Unmanned Aerial Vehicles to better monitor these zones, especially during the non-hunting season when the reserve is practically inaccessible for rangers.

Key words: Protected area management, illegal grazing, poaching, agricultural encroachment, logging, high pressure zones, season, patrol system

INTRODUCTION

Global biodiversity is in decline (Butchart et al., 2010; Craigie et al., 2010) and drivers of this declines, such as, illegal resource extraction added to climate change effects, are increasing (Bennett et al., 2002; Mackenzie et al., 2012; Laurance et al., 2012; Critchlow et al., 2015).

In common with most protected areas in West Africa, the W Biosphere Reserve of Benin is impacted by illegal acts often by local populations surrounding the protected area (Tiomoko, 2014). Cohabitation of local communities in and around protected areas with wildlife is an ongoing problem faced by managers and communities that they find difficult to resolve (Niagate et al., 2005). In fact, these communities do not perceive the reserve as the managers and conservationists do, but as a source of resources needed to support their livelihoods (Allah-Demngar & Falmata, 2003). Significant biodiversity loss within protected areas is often the consequence of this illegal resources exploitation (Barnes, 2002; Bennett et al., 2002;

Jachmann, 2008; Critchlow et al., 2015; Stirnemann et al., 2018). The consequences of illegal activities within protected areas can be profound (Bennett et al., 2002; Niagate et al., 2005; Craigie et al., 2010; Becker et al., 2013; Lindsey et al., 2013) and range from ecological cascades due to loss of keystone species to total habitat loss due to land conversion (Green et al., 2013; Critchlow et al., 2015).

In Benin, 58 gazetted forests (category VI according to the IUCN Protected Area classification) and about 3,000 sacred groves, covering about 2.7 million hectares or nearly 22 per cent of the country, constitute the protected areas network (SPANB, 2011). Unfortunately, most of these areas have almost disappeared. Despite multiple efforts since the creation of the National Center of Wildlife Reserves Management (“Centre National de Gestion des Réserves de Faune-CENAGREF”) in 1996 to better manage the two national parks of Benin (Biosphere Reserves of W and Pendjari), they have continued to be degraded by substantial human pressure (Tiomoko, 2014).

W National Park is subject to poaching, illegal grazing, agricultural encroachment and illegal logging (PAPE, 2014). However, the spatio-temporal variation of illegal activities is poorly understood within most protected areas (Becker et al., 2013; Lindsey et al., 2013). Determining patterns of illegal activities would enable more effective patrol and potentially reduce the decline in biodiversity within protected areas (Critchlow et al., 2015).

Most studies do not consider the full range of illegal activities that occur within a protected area and assess either temporal or spatial variation alone (Mackenzie et al., 2012; Plumptre et al., 2014). Moreover, previous research on illegal resource-use mainly focused on single activities, such as hunting for bushmeat (Nuno et al., 2013; Watson et al., 2013), illegal logging (Green et al., 2013; Mackenzie & Hartter, 2013), or harvesting of rare or medicinal plants (Young et al., 2011). Single activity assessments do not provide a comprehensive understanding of combined impacts, while managers need to know the temporal and spatial magnitudes and dynamics of all classes of illegal activities if they are to make informed decisions on resource allocation (Critchlow et al., 2015).

This study analyses the spatio-temporal trends of illegal activities in W Biosphere Reserve of Benin based on ranger-collected data in order to provide guidance for the patrol system by: (i) describing the extent of illegal activities, (ii) identifying zones of high pressure for each class of illegal activity and (iii) evaluating their seasonal variation. We hypothesise that agricultural encroachment, illegal grazing and logging will be more concentrated at the edges of the reserve and that poaching incidents will be more prevalent far away from roads and park boundaries (Watson et al., 2013; PAPE, 2014; Critchlow et al., 2015). We also predict that illegal activities are likely to be less common in the reserve during the hunting season due to the presence of tourists and licensed hunters.

METHODS

Study area

The W Biosphere Reserve of Benin (WBR/Benin), commonly called W National Park (IUCN Management Category II) is located at the extreme northwest of the Republic of Benin about 670 km from Cotonou. It is one of the largest components of the W Regional Park Complex constituting the first Transboundary Biosphere Reserve in West Africa shared by three countries: Benin, Burkina Faso and Niger. The WBR/Benin covers an area of 780,480 ha (62.44 per cent) of the 1.25 million ha of land in the complex (ECOPAS, 2005). The WBR/Benin is a major national park in

West Africa around a meander of the River Niger shaped like a “W”. It is this river shape that gives the name W to the Reserve. Its official gazettal covers W National Park (563,280 ha), Djona Hunting Zone (115,200 ha) and the eastern part of the Hunting Zone of Atakora called the Hunting Zone of Mekrou (102,000 ha).

The WBR/Benin has about 200,000 people living within it and on its periphery, which frequently creates conflicts between park managers, herders and farmers.

In order to better identify high pressure areas of each illegal activity, we subdivided the WBR/Benin into seven zones with five zones in the core area of the W National Park (Park 1, Park 2, Park 3, Park 4 and Park 5) and the two Hunting Zones (HZ Djona and HZ Mekrou). This subdivision follows a regional track (from Alfakoara to Triple Point), one of the main tracks in the reserve that links Karimama and Founougo villages, and the administrative boundary between Karimama and Banikoara Township in the reserve (Figure 1).

Data collection

Our data set consisted of 1,960 position records from ranger patrols conducted between January 2012 and December 2015 within the WBR/Benin. During all patrol activities (by foot and vehicle), when sighting evidence of illegal activities rangers record on patrol cards all instances of illegal activity with their date, observations and position using the Global Positioning System (GPS). Using these patrol cards, illegal activity

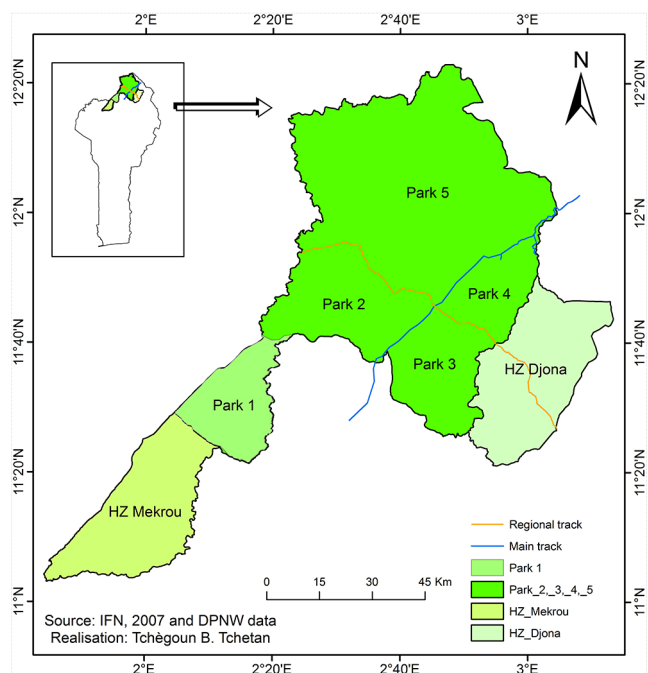


Figure 1. Map zoning of W Biosphere Reserve of Benin (WBR/Benin)

incidents are grouped together with their geographic coordinates and date of recording.

Following PAPE (2014), we defined four illegal activities classes (poaching, illegal grazing, logging and agricultural encroachment). Each incident recorded by the patrol teams was assigned to one of these classes of illegal activities. For example, incidents such as clearing new land for farming were grouped together as agricultural encroachment; while detection or arrest of poachers, animal carcasses with horns, tusks, etc. removed, poachers' camps and bicycle or motorbike tracks were classified as poaching; herders or their camps and herds of cattle were grouped as illegal grazing, and logging sites or logs were grouped as logging.

Geographic coordinates for each incident were used to identify the location in the reserve by zone. The recording dates were used to group incidents by year and season (the hunting season occurs from 15 December to 15 May and the non-hunting season from 16 May to 14 December). The hunting season roughly corresponds to the dry season and the non-hunting season to the rain season in northern Benin where WBR/Benin is located.

For the identification of the high pressure zones for each illegal activity, the analyses took into account four years' data (2012 to 2015), but for the evaluation of seasonal variation, the analyses only took into account three years' data (2013–2015) since the recording dates for the 2012 incidents were not available.

Statistical analysis

The constituted data matrix was subjected to statistical analysis using R (R Core Team, 2016) and QGIS. Descriptive statistics were used to compute and

describe the extent of illegal activities within the WBR/Benin.

To identify high pressure zones of illegal activities in the reserve, incidents were grouped by type of illegal activity in each zone to form the starting matrix. Fisher exact test was used to determine the relationship between activities and zones. A simple correspondence factor analysis was performed in R to determine the relationship between activities and zones. QGIS was also used to map each illegal activity distribution within the reserve.

To evaluate seasonal variation, illegal activities incidents were grouped by hunting season and non-hunting season in each year and with their geographic coordinates projected in QGIS to draw pressure maps for each season.

RESULTS

Extent of illegal activities within the WBR/Benin

Grazing was the most frequently reported illegal activity followed by poaching, agricultural encroachment and logging (Table 1). This pattern of occurrence was consistent across years ($\chi^2 = 89.104$; $p < 0.001$). More incidents were recorded in 2013 and 2014 (Table 1).

Spatial distribution of illegal activities within the WBR/Benin

The magnitude of illegal activities varies significantly across the zones ($\chi^2 = 894.56$; $p < 0.001$) (Table 1). Results of the correspondence analysis between illegal activities and zones indicated that the first two dimensions address 94.84 per cent of the variance (Figure 2).

Analysis of contributions and quality of representation as well as the projection of the activities and zones on

Table 1. Recorded incidences by illegal activity during each year and in each park zone

Illegal activities	Number of recorded incidences											
	Year					Location						
	2012	2013	2014	2015	Total	HZ Djona	HZ Mekrou	Park 1	Park 2	Park 3	Park 4	Park 5
Illegal grazing	202	405	335	195	1137	334	1	34	237	291	96	144
Poaching	67	118	186	98	469	102	8	40	107	96	28	88
Agricultural encroachment	30	110	96	49	285	46	4	0	116	102	0	17
Logging	1	51	5	12	69	3	35	5	0	26	0	0
Total	300	684	622	354	1960	485	48	79	460	515	124	249

the two factorial dimensions indicated that there is an affinity between logging and the HZ Mekrou on the one hand and between illegal grazing and HZ Djona on the other (Figure 2, dim 1). In addition, there is an affinity between agricultural encroachment and the Park 2 and Park 3 zones. Poaching and illegal grazing are close to the origin of the two axes and are surrounded by the HZ Djona, Park 1, Park 2, Park 3, Park 4 and Park 5 zones (Figure 2, dim 2).

In summary, illegal grazing and poaching are concentrated in practically all zones of the W Biosphere Reserve except the HZ Mekrou. Agricultural encroachment is mainly concentrated in Park 2 and Park 3. The HZ Mekrou is a preferred zone for loggers where logging is frequently recorded (Figure 2).

Within WBR/Benin, the highest pressure zones are HZ Djona, Park 3, Park 2, Park 5 and Park 4, respectively (Figure 3). Poaching and illegal grazing are as concentrated in the central zones of the reserve as on its peripheries, except the HZ Mekrou (Figure 3-a, b). On the north-eastern peripheries of the HZ Djona and Park 5 and especially on the southern peripheries of Park 2 and Park 3, agricultural encroachment is the highest pressure (Figure 3-c). Logging is the only pressure threatening HZ Mekrou (Figure 3-d).

Seasonal variation of activities within the WBR/ Benin

The Fisher exact test (Table 2) indicates a strongly significant relationship between illegal activities and the season regardless of the year (p-value <0.001).

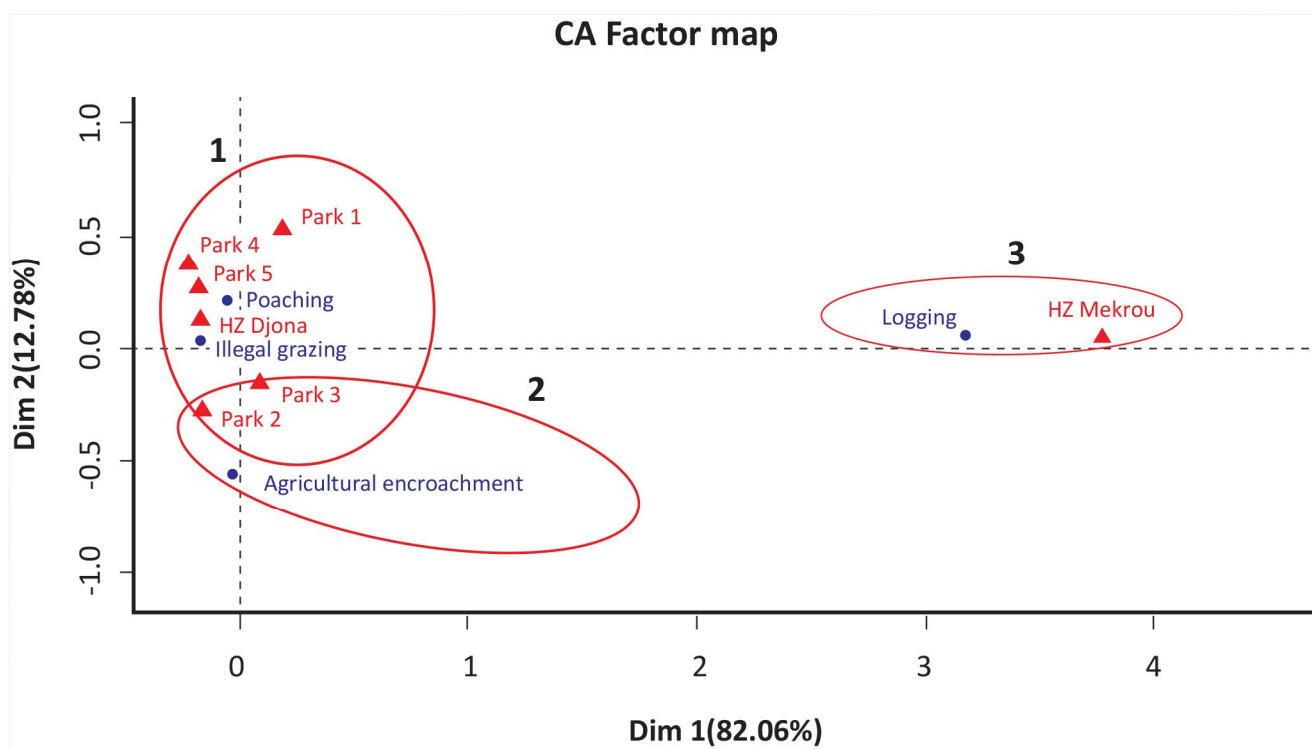


Figure 2. Positioning of illegal activities and zones on 2 mains factorial axes

Table 2. Recorded incidences by illegal activity during each season within WBR/Benin

Illegal activities	Number of recorded incidences						All data	
	2013		2014		2015		HS	NHS
	HS	NHS	HS	NHS	HS	NHS	HS	NHS
Illegal grazing	44	361	107	228	43	152	194	741
Poaching	38	80	83	103	49	49	170	232
Agricultural encroachment	38	72	47	49	38	11	123	132
Logging	2	49	0	5	2	10	4	64
Probability (p-value)	< 0.001		< 0.001		< 0.001		< 0.001	

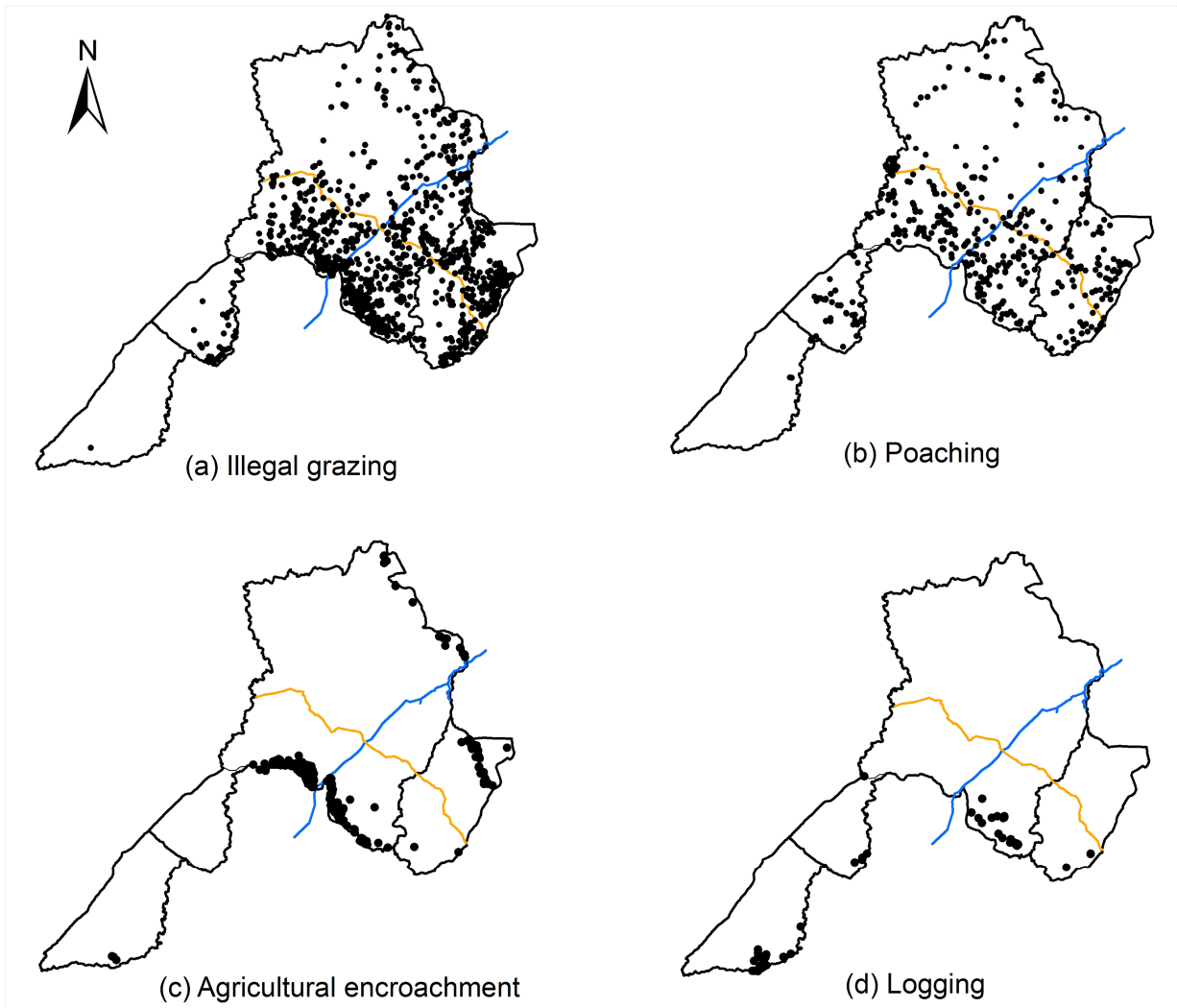


Figure 3. Spatial distribution of illegal activities incidents within the WBR/Benin

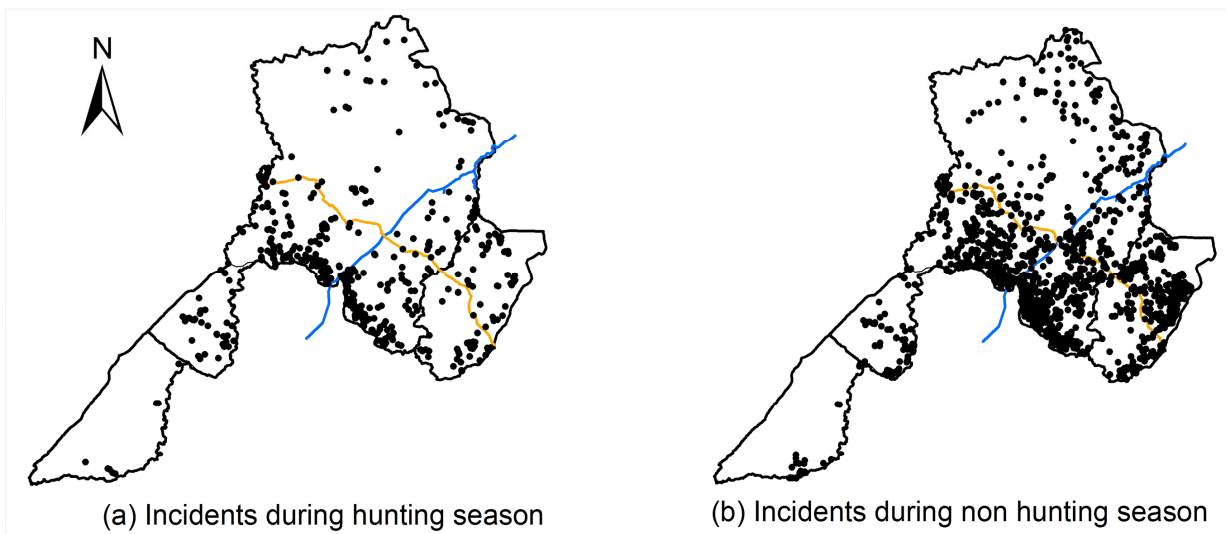


Figure 4. Season variation of illegal activities incidents within the WBR/Benin



Lion (*Panthera leo*) in the reserve © Gerard N. Gouwakinnou

Whatever the year and the type of illegal activity, the incidents are less common during the hunting season than non-hunting season (Figure 4).

DISCUSSION

Extent of illegal activities within the WBR/Benin

In the past, the W Biosphere Reserve of Benin was subject to an increase in illegal wildlife trafficking and increased poaching (PAPE, 2014). From our results, the problems of illegal grazing and poaching within WBR/Benin are still critical. In fact, illegal grazing remained the most common problem within the reserve followed by poaching and agricultural encroachment. Logging was not a major problem and was confined to one part of the reserve. Illegal activities were more common in 2013 and 2014 which may be the result of the reduced presence of rangers in the reserve during these years due to technical and financial difficulties with staff management according to the W Park Manager (pers comm. Grégoire Djijsou).

The high rate of illegal grazing in the WBR/Benin is particularly due to its Transboundary Reserve status

which results in grazing pressure not only from Benin but also from Niger and Burkina Faso transhumants. Illegal grazing is one of the main problems for the sustainable management of WBR/Benin. It currently creates conflicts between herders and farmers, wildlife and cattle (carnivore attacks on cattle), and uncontrolled fire in the reserve (herders use fire to stimulate vegetation regrowth for their cattle).

However, though illegal grazing is the most commonly detected illegal activity in WBR/Benin, its impact on the ecological integrity of the reserve may be less than the other threats as, according to Bennett et al. (2002), the two main threats to wildlife across the world are habitat loss (agricultural encroachment and illegal logging) and poaching.

Our results show poaching as a major threat commonly detected in WBR/Benin. The problem of poaching in protected areas has been widely documented and discussed (Bennett et al., 2002; Becker et al., 2013; Lindsey et al., 2013; Nuno et al., 2013; Stirnemann et al., 2018). According to Stirnemann et al. (2018), poaching for consumption and trade of wildlife

constitute the key causes of biodiversity loss. It is therefore urgent that park managers take seriously the problem of poaching on this reserve and empower rangers by better equipping them.

Moreover, even though agricultural encroachment and logging incidents are lower in WBR/Benin, they constitute major threats. According to Tranquilli et al. (2014), agriculture and logging are the most common indirect threats to wildlife and most prevalent in West Africa protected areas. In fact, the patrol cards used to construct our data matrix show that tens or even hundreds of hectares and logs from taller trees of forest have been destroyed by agricultural encroachment and logging, respectively. The impacts of these activities on ecosystems can be profound and range from ecological cascades to total habitat loss due to extraction of keystone species (logging) and land conversion (agricultural encroachment), respectively (Green et al., 2013; Mackenzie & Hartter, 2013; Critchlow et al., 2015). In WBR/Benin, the problem of logging is more



New clearing for land conversion © Tchègoun B. Tchetan

worrying because in the past, this activity did not occur according to the W Park Managers. Two species commonly encountered in the area that are subject to illegal logging are Senegal rosewood (*Pterocarpus erinaceus*) and African mahogany (*Azelia africana*). These species are amongst the most endangered species in Benin.

Spatial distribution of illegal activities within the WBR/Benin

The distribution of illegal activities was highly spatially variable. Illegal grazing and poaching occur across WBR/Benin except in the Hunting Zone of Mekrou. The co-occurrence of these two threats may be because the majority of transhumants within the reserve both bring their grazing animals with them and also poach for food and commercial purposes.

Illegal logging is concentrated in the Hunting Zone of Mekrou. The presence of the Mekrou River in this zone provides optimal ecological conditions for growth of gallery forests which contain larger trees. This accords with the results of Mackenzie et al. (2012), and Mackenzie & Hartter (2013), who showed that illegal logging was more common where there are taller trees on the peripheries of protected areas.

Rapid population growth in Benin, which has been increasing at nearly 3 per cent annually (INSAE, 2013), has added to land shortage prompting farmers to clear new land including encroaching on protected areas. The WBR/Benin has not escaped this pressure. Indeed, its peripheral zones are experiencing strong agricultural pressure leading to degradation and fragmentation. The north-eastern peripheries of the HZ Djona and Park 5 and especially the southern peripheries of the Park 2 and Park 3 zones are particularly affected, because they



Bush meat on bicycle © Gerard N. Gouwakinnou

are closer to human habitation. Similar results were found by Mackenzie & Hartter (2013) and Plumptre et al. (2014), with illegal activities like agriculture being more common near the boundaries of protected areas.

Seasonal variation of activities within the WBR/Benin

Within WBR/Benin, illegal activities vary from season to season. In general, the results confirm our basic hypothesis that illegal activities are less observed during the hunting season than the non-hunting season, whatever the activity class, year or zone considered. This is likely to be because tourists' presence during the hunting season constitutes a deterrence to illegal activities in the reserve. During the non-hunting season (rain season), patrol activities are lower within the reserve because of the inaccessibility of some zones to rangers due to flooding and dense vegetation.

CONCLUSION

W Biosphere Reserve of Benin is under heavy human pressure, including illegal grazing, poaching, agricultural encroachment and logging. The consequences of these activities on ecosystems are well established from habitat loss to declines in wildlife populations.

To control agricultural encroachment, patrol and surveillance efforts should be focused on the north-eastern peripheries of the HZ Djona and Park 5 and especially the southern peripheries of the Park 2 and Park 3 zones. To prevent logging, efforts should be focused on the Hunting Zone of Mekrou. Illegal grazing and poaching are the most widespread activities in the reserve and need to be patrolled more frequently in almost all zones.

This information is very important to ranger deployment and demonstrates the value of a full spatio-temporal analysis of illegal activities. However, because spatial and temporal changes in illegal activities occurred, regular patrols throughout the protected area, even in zones of low occurrence, are also required.

We recommend to W National Park managers to develop new technologies including the use of Unmanned Aerial Vehicles to better monitor the zones at greatest risk for each class of illegal activity, especially those that are virtually inaccessible to rangers in order to potentially reduce pressure during the rainy-season (non-hunting season).

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RESUMEN

Este estudio analiza las tendencias espacio-temporales de las actividades ilegales en la Reserva de la Biosfera de la Región W de Benín con el fin de proporcionar orientación para la planificación del sistema de vigilancia. Utilizamos datos recopilados por los guardabosques sobre las actividades ilegales en la reserva desde 2012 hasta 2015. El pastoreo ilegal es la actividad ilegal más común observada en la reserva (1137 incidentes), seguida de la caza furtiva (469 incidentes), la invasión agrícola (285 incidentes) y la tala (69 incidentes). La distribución de estas actividades en la reserva depende en gran medida de las zonas y también varía según las estaciones. En general, los incidentes de actividades ilegales fueron más frecuentes durante la temporada de veda que durante la temporada de caza debido a las inundaciones, la inaccesibilidad de los caminos y el cierre de la cubierta vegetal que limitan las actividades de patrullaje durante la temporada de prohibición de la caza. Con base en estos resultados, los administradores del Parque Nacional de la Región W pueden identificar zonas de alta presión humana donde es necesario intensificar los esfuerzos de vigilancia de los guardabosques. Proponemos el uso de nuevas tecnologías, tales como los vehículos aéreos no tripulados, para un mejor monitoreo de estas zonas, especialmente durante la temporada de veda cuando la reserva es prácticamente inaccesible para los guardabosques.

RÉSUMÉ

Cette étude s'est intéressée à l'analyse de la variation spatio-temporelle des pressions anthropiques dans la Réserve de Biosphère W du Bénin afin de mieux orienter le système de surveillance. Nous avons utilisé les données de patrouille collectées par les éco-gardes sur les activités illicites de 2012 à 2015 dans la réserve. Le pâturage est l'activité illicite la plus observée dans la réserve (1137 incidences). Il est suivi du braconnage (469 incidences), de l'empiètement agricole (285 incidences) et de l'exploitation forestière (69 incidences). La distribution de ces activités dans la réserve est fortement dépendante des zones et varie également d'une saison à une autre. De façon générale, les résultats ont montré que les incidences d'activités illicites sont plus observées en saison non-cynégétique qu'en saison cynégétique. Cette situation est due à l'inondation du parc, la difficulté d'accès aux pistes et la densité de la végétation qui limitent les activités de patrouille en cette saison. A travers cette recherche, les gestionnaires du Parc du W seront désormais conscients des zones à fortes pressions anthropiques où les efforts de surveillance des éco-gardes devraient être redoublés et intensifiés. Nous recommandons l'utilisation de nouvelles technologies comme les drones pour mieux surveiller ces zones, en particulier pendant la saison non-cynégétique lorsque la réserve est pratiquement inaccessible aux éco-gardes.



PRIVATELY PROTECTED AREAS AND BIODIVERSITY STEWARDSHIP IN SOUTH AFRICA: CHALLENGES AND OPPORTUNITIES FOR IMPLEMENTATION AGENCIES

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ABSTRACT

Habitat loss and degradation are among the most pressing threats facing global biodiversity. Increasing the network of both protected areas and conservation areas is considered an important mechanism for conserving biodiversity and improving land management. Private land conservation and the establishment of privately protected areas has emerged as a cost effective tool for expanding the conservation estate. However, public and private institutions are limited in their financial and human capacity required to undertake this work. This research investigated the challenges facing the conservation agencies implementing the biodiversity stewardship initiative in South Africa, and the opportunities which may be leveraged to further strengthen these organisations. The research targeted practitioners and included a series of focus group discussions and an online questionnaire. Recommendations arising from this research are structured into four major themes: enhancing government–NGO collaboration; landowner partnerships; personnel capacity; and financial opportunities. A logic model to guide government–NGO collaboration is presented, along with a typology of the benefits and support mechanisms available to landowners involved in biodiversity stewardship. PLC initiatives must remain flexible in order to respond to changing socio-economic conditions. This research is intended to help facilitate such flexibility in private land conservation and privately protected area programmes.

Key words: biodiversity stewardship; collaboration; challenges; opportunities; landowners; private land conservation

INTRODUCTION

Habitat loss and degradation are among the most pressing threats facing global biodiversity, and this is no different in South Africa (Sala et al., 2000; Driver et al., 2012; Marnewick et al., 2015). Increasing the network of both protected areas and conservation areas is considered one of the most important mechanisms for conserving biodiversity and improving land management, whilst offering a range of socio-economic benefits (Watson et al., 2016). The Convention on Biological Diversity (CBD) Aichi Biodiversity Target 11 calls for: “at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically

representative and well connected systems of *protected areas* and *other effective area-based conservation measures*” (CBD, 2010; emphasis added). Private Land Conservation (PLC), and in particular the creation of Privately Protected Areas (PPAs), has emerged in recent years as a cost effective tool for achieving protected area and conservation area expansion, whilst reducing the capacity burden placed on national governments through these additional areas (Fishburn et al., 2009; Gallo et al., 2009; Stolton et al., 2014; Selinske et al., 2015; Bingham et al., 2017; Hardy et al., 2017; Drescher & Brenner, 2018). Recent reports indicate there are approximately 14,296 PPAs spread across 25 countries worldwide, as reported in the IUCN World Database on Protected Areas (WDPA) (Bingham et al., 2017); however this number may be higher due to low levels of

reporting of PPAs on the WDPA (Stolton et al., 2014). The rapid growth in declaration, and in many cases important contributions to conservation targets, highlights the need for more in depth understanding of PPA programmes (e.g. Mitchell, 2005; Fitzsimons, 2015; Hardy et al., 2017; Hora et al., 2018).

South Africa's legislative and policy framework regarding the formal declaration of protected areas facilitates declarations on privately and communally owned land. This facilitation is made possible by the national biodiversity stewardship initiative. The term stewardship is used in varying contexts across the literature (Cockburn et al., 2018), but broadly relates to the actions or principles applied for improving the sustainability of socio-ecological systems (Chapin et al., 2010). In South Africa, biodiversity stewardship is an approach to securing protection for land with important biodiversity elements through agreements with private and communal landowners, driven by conservation authorities and supported by NGOs (Barendse et al., 2016; SANBI, 2017). Thus for the purposes of this research, the term biodiversity stewardship refers specifically to the biodiversity stewardship initiative – the programme which drives the establishment of PPAs and conserved areas in South Africa (Cumming & Daniels, 2014). The initiative was developed in the early 2000s in response to systematic conservation planning work which illustrated the large amount of critical biodiversity remaining on private and communal land (Cowling et al., 2003).

Currently there are five different types of biodiversity stewardship agreements. These exist in a hierarchy of protected areas and conservation areas, with differing levels of commitment, duration, permanence and management restrictions, which correspond with increasing availability of incentives (SANBI, 2017; Mitchell et al., 2018). The various agreements align with the IUCN guidance for either PPAs (Dudley, 2008; Stolton et al., 2014) or criteria for identifying “other effective area-based conservation mechanisms (OECMs)” (IUCN WCPA, 2018), depending on their particular legal status, duration and intention (Mitchell et al., 2018). Government funded biodiversity stewardship programmes have been developed in each of South Africa's nine provinces to drive implementation of these agreements. Biodiversity stewardship is well regarded in South Africa as an efficient and economic tool for achieving expansion of the national protected area estate, and improving environmental management of the broader landscape (SANBI, 2017). The South African National Biodiversity Strategy and Action Plan (NBSAP) recognised the critical role that biodiversity stewardship can play as an

approach to protect and manage land in conservation priority areas (Government of South Africa, 2015). The National Department of Environmental Affairs (2016) reports over 564,000 hectares of important areas for biodiversity conservation being declared, equating to approximately 40 per cent of the national protected area estate. The South African sector has also made important contributions to the development of the IUCN policy regarding PPAs and private land conservation (Stolton et al., 2014; Bingham et al., 2017; Mitchell et al., 2018).

Despite the successes of biodiversity stewardship and its collaborative implementation across South Africa, challenges exist, most notably financial and capacity resource constraints. Provincial governments tasked with leading its implementation are increasingly limited by available financial and human resources. Through their mission to conserve biodiversity and support government departments to achieve conservation outcomes, non-governmental organisations (NGOs) have increasingly assisted to implement PLC in South Africa (Pasquini et al., 2011). The Biodiversity Stewardship Business Case report recognised the role of NGOs and the need to build partnerships between NGOs and government conservation agencies (SANBI, 2017).

Although the growth of NGO involvement has provided much needed support for government departments to allow for the continued declaration of protected areas through biodiversity stewardship, NGOs do face certain challenges. NGOs can be limited by short-term funding cycles, which may inhibit their long-term involvement at sites. A long-term outlook is often necessary for negotiations with landowners and in particular for support to existing sites. Additional challenges faced by NGOs include the prohibitive costs associated with procuring services such as legal expertise; the provision of additional fiscal benefits for landowners to encourage involvement in biodiversity stewardship; and clarity regarding NGO and government agency roles and responsibilities (Fitzsimons, 2015). The provincial conservation agencies implementing biodiversity stewardship face many of the same challenges. Thus, although biodiversity stewardship has achieved positive outcomes for conservation in South Africa, as with any conservation initiative, it is important to undertake an evaluation of the programme at different stages in order to further improve its implementation (Von Hase et al., 2010; Keene & Pullin, 2011; Rissman & Sayre, 2012).

This research investigated the challenges facing the biodiversity stewardship community of practice in South Africa, specifically the government agency and NGO staff tasked with implementation. The study utilised a

participatory approach, and engaged a wide range of biodiversity stewardship practitioners, from programme managers in government agencies to NGO extension officers working with landowners, as well as key technical experts operating within this sector. Previous research on biodiversity stewardship in South Africa has focused primarily on landowners' perspectives of PLC and biodiversity stewardship (Pasquini et al., 2009; Selinske et al., 2015; Selinske et al., 2017). Landowners' perspectives are essential in structuring relevant PPA and PLC programmes; however, without well-resourced implementation agencies driving these programmes and supporting landowners, biodiversity stewardship or similar

initiatives are likely to decline (Prado et al., 2018). The research presented here can help to avoid such a situation and support the sustainability of PPA and PLC initiatives, both in South Africa and globally.

METHODS

The review of challenges and opportunities within the South African biodiversity stewardship community of practice used both qualitative and quantitative techniques. This study involved two separate focus group discussion sessions held in the Western Cape Province and an online questionnaire which was circulated nationally.



Figure 1. Biodiversity stewardship process model



Moutonshoek Protected Environment – a recently declared Privately Protected Area in South Africa comprising of multiple landowners and including conservation and agricultural land © Dale Wright

Focus group sessions

Each year many of the individuals and organisations involved in biodiversity stewardship and protected area expansion in the Western Cape meet to share lessons learnt and experiences in order to grow capacity within this community of practice. These “Peer Learning Forums” allow for knowledge sharing, networking and a strategic re-alignment of goals. Over time this group has expanded from a purely government agency led constituency, to one which includes role players such as NGOs, landowners and private consultants.

A focus group session at the 2015 Western Cape Biodiversity Stewardship Peer Learning Forum, involving 44 participants, included a facilitated discussion focused on the following topics: 1) Challenges facing the sector, 2) Opportunities to overcome these challenges and 3) Designing the ideal scenario for biodiversity stewardship to proceed. Workshop participants were assigned random groups and tasked with producing their own sets of challenges and opportunities. The groups’ contributions were then combined into a single list. These discussions were continued during the 2016 Peer Learning Event. Prior to that meeting, the results from the 2015 Peer Learning Event focus group were summarised to remove duplicate items. Each of the final items was allocated to

one of four constructs corresponding to some of the major resources underpinning biodiversity stewardship implementation (Figure 1). These resource constructs include: Operational Capacity, Personnel Capacity, Collaborative Partnerships and the Extension Toolbox. Additional resources include Stewardship mechanisms, Reactive stewardship and Advocacy / awareness (Figure 1); however these were not considered for the purposes of this research. At the 2016 Peer Learning Forum, the participants were asked to vote on what they felt were the most pressing challenges and most catalytic opportunities.

All participants had a maximum of ten votes which could be cast across 65 stated challenges and opportunities. Participants were requested to split their ten votes equally across the challenge and opportunity items. The total number of votes for each challenge and opportunity were then summed to determine the highest ranking challenges and opportunities within each resource construct. The votes were converted into an overall percentage based on the total number of votes received as a proportion of the total number of workshop participants. A final focus group involving all workshop participants discussed these rankings and provided consensus as to why these statements ranked highest, whilst also developing mechanisms to address

the highest ranking challenges and opportunities. The minutes from that discussion were also consulted during this research.

Online questionnaire

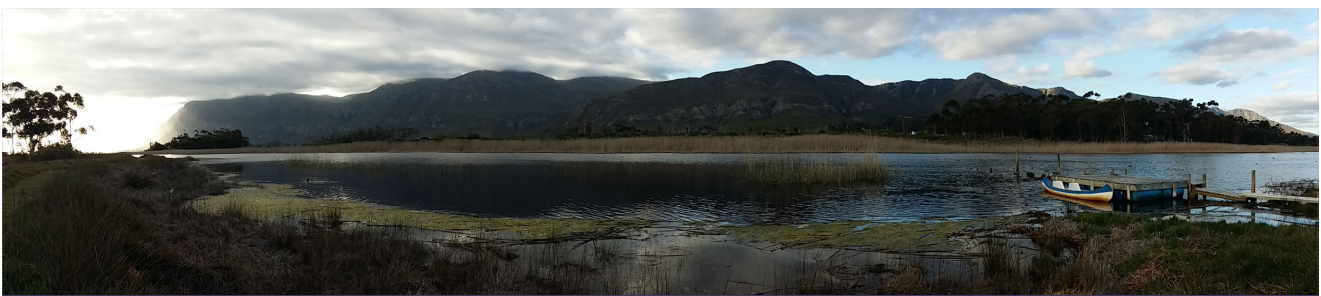
In order to expand the scope of this review beyond solely the Western Cape community, an online questionnaire was designed and circulated nationally from February to July 2017, using the online platform provided by Google Surveys (Appendix 1 Supplementary information). The questionnaire was primarily circulated using targeted email lists which include many of the practitioners and experts working in biodiversity stewardship in South Africa. Practitioners were then asked to further share the questionnaire to others in their networks. The ease of online completion was intended to encourage participation and increase the number of responses received. As with standard survey practice, reminders were sent to participants at intervals to improve the response rate (Dillman et al., 2009).

The questionnaire included a total of 48 questions. The first section included three questions regarding the demographics of participants with respect to their employment in the sector. The second section focused on challenges to biodiversity stewardship, including an open-ended question prompting respondents to suggest challenges they faced in their own work. This was followed by a series of 20 statements which included the highest ranking challenges as determined by the voting during the focus group sessions. Respondents were asked to indicate their level of agreement or disagreement with each of the 20 statements. The third section, focused on opportunities, including three open-ended questions, addressing the perceived benefits of biodiversity stewardship for participating landowners, the opportunities which exist to enhance the sector and suggestions for enhancing government–NGO collaboration. A series of 20 statements was used to elicit further information regarding the highest ranking

opportunities as previously identified. The open-ended items preceded the statements in the challenge and opportunity sections in order to avoid prompting and bias in the suggestions received from the open-ended questions (Babbie, 2004).

The open-ended questions were analysed using content analysis in which all items representing a common theme are grouped together and major themes identified. The responses for the open-ended question pertaining to enhancing government–NGO collaboration were reviewed and similar responses grouped, thus providing a final list of recommendations. These recommendations were subsequently developed into a logic model to illustrate the sequential steps which may be taken to improve collaboration. In a similar manner, the responses for the open-ended question relating to the benefits and support mechanisms available to landowners was also summarised and grouped according to an overall typology of benefits.

The statements were analysed quantitatively, using a five point Likert scale from 1 = strongly disagree to 5 = strongly agree (Likert, 1932; Babbie, 2004). The mean score was calculated for each statement or item. Subsequently, the mean scores were translated into a percentage indicating the level of agreement, such that scores greater than 50 per cent indicate agreement with the item. The final percentage scores from the online questionnaire were used to rank the challenge and opportunity items. The individual items were subsequently reviewed and common themes across challenges and opportunities emerged. These common themes form the sub-headings within the discussion. Where relevant, the initial challenge and opportunity items have been referenced in the results and discussion using the following format; (1.1, Table 1) – indicating Table 1, section 1; item 1 – as per the numbering of items in the relevant table. A number of recommendations were produced during this research



The Klein River Estuary represents important habitat for birds and other biodiversity. Negotiations with private landowners are currently underway here, with the aim of creating a Nature Reserve comprising of multiple properties © Dale Wright

and these were also summarised and included here, with a distinction between those recommendations already being applied by the sector and potential new opportunities.

RESULTS

Results from both the voting which took place during the second focus group and the online questionnaire are presented here in Tables 1 and 2. Items are presented in groupings under each of the resource constructs identified as the basis for implementing biodiversity stewardship (Figure 1). The “Forum” results indicate the total percentage of votes received in favour of an item during the 2016 Peer Learning Forum, given that participants were allowed multiple votes. The “Online” column represents the percentage level of agreement which was obtained for each item from the online questionnaire. The items (statements) are ranked within each resource construct by their mean score obtained from the online questionnaire.

A total of 42 participants were involved in the 2016 Western Cape Peer Learning Forum, representing 22 government staff and 20 NGO staff. A total of 40 responses were received for the online questionnaire, representing NGO staff (n=23), government agency employees (n=15) and individuals from the private sector / consultants (n=2). Respondents had an even spread of experience working in the sector; 0 – 5 years

(n=12), 5 – 10 years (n=17) and 10+ years (n=11). The majority of respondents were directly involved in biodiversity stewardship implementation through work as Programme or Project Managers (n=20) or Extension Officers (n=12). Other positions within the sector which were represented included staff from the department of agriculture (n=2), private landowners (n=2), technical or legal support (n=1) and one academic.

The questionnaire generally received high levels of agreement from the broader community (Tables 1 & 2). This supported the previous focus group discussions and final prioritisation of items for inclusion in the questionnaire.

Challenges

The issue of sustainable, long-term funding for permanent staff received the highest number of votes during the forum session, and was supported by a correspondingly high score from the online questionnaire (3.2, Table 1). Item 2.1 (Table 1) related to the challenge of funding for the ongoing management of sites scored the second highest of all challenge items in the questionnaire. Item 1.1 (Table 1) related to the lack of political will to support biodiversity stewardship received the highest score from the online questionnaire, with a correspondingly high number of votes during the forum. In addition, the items relating to knowledge required by extension officers (2.2, Table 1)



NGO staff members assessing a potential Biodiversity Stewardship site in the grassland biome © Daniel Marnewick

Table 1. Biodiversity stewardship challenges identified by forum participants and online questionnaire

Resource construct	Item	Forum	Online
1. Collaborative partnerships	1.1 High level political will to support and adequately finance biodiversity stewardship is lacking.	38	93
	1.2 Landowners often have misconceptions regarding biodiversity	7	86
	1.3 The sector is not always able to assist willing landowners who do not	5	81
	1.4 There is a lack of clarity regarding each partner's roles and	7	62
	1.5 NGOs do not properly structure their engagement with government	5	56
2. Operational capacity	2.1 Funding for maintenance of established sites is a challenge.	31	92
	2.2 Practitioners require a detailed understanding of ecological	17	81
	2.3 NGO short-term funding cycles inhibit progress.	14	80
	2.4 The legal costs for proclamation are prohibitive.	10	72
	2.5 Setting land aside for protection is often in direct competition with	10	72
3. Personnel capacity	3.1 There is a lack of succession planning in extension services.	12	91
	3.2 Sustainable, long-term funding for permanent staff is lacking.	67	91
	3.3 Extension officers require a highly diverse skills set.	14	87
	3.4 Extension officers do not receive training in social science skills such	29	78
	3.5 Limited knowledge of the previous history of landowner	0	74
4. Extension toolbox	4.1 Limited capacity in the legal sector (including knowledge of declaration processes, willingness or time to assist, or other capacity	29	79
	4.2 There is a lack of technical (non-financial) resources to assist	10	76
	4.3 There is a lack of relevant benefits for landowners.	17	74
	4.4 There is a lack of comprehensive training materials for new	19	74
	4.5 There is no clear legal or process framework for declaring	10	53

and the extension officers' skills set (3.3, Table 1) both received high levels of agreement in the online questionnaire. There was also strong agreement in the online questionnaire with the statement relating to succession planning for the sector (3.1, Table 1); however this was not as strongly supported by the forum votes. In certain instances, the low levels of agreement or number of votes also provide important insights. Items 1.4 and 1.5 (Table 1) related to government–NGO partnerships and collaboration, both scored low, in both the forum and online results. Overall the national community showed convergence with the top priority challenges as described by the Western Cape community, due to the high number of

items with a mean score above 50 per cent (n=20, Table 1).

Opportunities

Collaboration between partners using complementary strengths was considered a major opportunity for the sector, with the highest mean score of any opportunity item from the online questionnaire (3.1, Table 2). Further items related to partnerships which received strong support in the online questionnaire included the item related to opportunities in co-funding and sharing limited financial resources (1.1, Table 2), creating co-funding partnerships and platforms (2.2, Table 2), applying a strategic approach to a region (1.3, Table 2)

Table 2. Biodiversity stewardship opportunities identified by forum participants and online questionnaire

Resource	Item	Forum	Online
1. Collaborative partnerships	1.1 Co-funding and sharing limited financial resources can enhance biodiversity stewardship.	14	89
	1.2 Landscape scale initiatives represent an opportunity to enhance	26	87
	1.3 A strategic approach to covering a specific region will enhance	31	86
	1.4 Private Sector support should be leveraged to enhance biodiversity	17	86
2. Operational capacity	2.1 Establishing collaborative endowment funds will support biodiversity stewardship.	24	90
	2.2 Creating co-funding partnerships and platforms will enhance the	10	87
	2.3 Alignment between business interests and the biodiversity conservation sector is an unexplored opportunity for biodiversity	24	85
	2.4 Promoting mixed land use zoning will allow for agricultural sector	33	83
	2.5 Existing Conservancies can provide a great platform for launching	12	79
3. Personnel capacity	3.1 Utilizing complementary capacity and technical strengths of various partners can enhance biodiversity stewardship.	10	93
	3.2 Local champions should be used to drive biodiversity stewardship.	21	86
	3.3 Improved environmental awareness in the general public can be used	10	80
	3.4 Improving landowner's capacity (including to manage environmental projects, drive proclamation processes, or maintain landowner	14	70
4. Extension toolbox	4.1 Pro-bono advertising options in newspapers should be established to reduce costs for biodiversity stewardship.	10	91
	4.2 Establishing a pro-bono legal and tax support platform will enhance	17	88
	4.3 Transferring institutional knowledge into practical learning materials	7	86
	4.4 A standardized national toolbox will improve extension officers'	12	86
	4.5 Establishing a common access information database will support	19	85
	4.6 Alternative mechanisms for formal protection on private land (outside of those currently described in the protected areas act) should be	14	85
	4.7 A poster template for the "Annual Plan of Operation" will enhance the long-term management and maintenance of biodiversity stewardship	19	75

and implementing landscape scale initiatives (1.2, Table 2). Financial opportunities also received strong support. Establishing collaborative endowment funds received strong support from both the forum and online questionnaire (2.1, Table 2), as did securing pro-bono advertising (4.1, Table 2) and pro-bono legal support

(4.2, Table 2). Aligning with business interests (2.3, Table 2) and securing private sector partnerships (1.4, Table 2) received high levels of support from both the forum and questionnaire, illustrating convergence between the different communities of practitioners. Items relating to financial opportunities generally



Species such as the threatened Martial Eagle rely on a network of state and privately protected areas to support their habitat requirements.
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received high levels of support (Items: 1.1, 2.1, 2.2, 4.1, 4.2; Table 2). Respondents were also in support of the item relating to utilising local champions to drive biodiversity stewardship (3.2, Table 2). There was also agreement in the online questionnaire with items relating to materials for supporting practitioners, including the standardised national toolbox (4.4, Table 2) and establishing a common access information database (4.5, Table 2).

Common themes which emerged from the open-ended question regarding government–NGO collaboration include: communication, drafting Memorandums of Understanding (MOUs) and formalising partnerships, obtaining high-level political support, financing and incentives, cross-department support, role differentiation and partnerships and shared responsibilities. These themes informed the development of a logic model for enhancing collaboration (Figure 2). Respondents also provided information regarding the benefits generated for, and support mechanisms available to, private landowners involved in biodiversity stewardship (Table 3). An overall summary of the major recommendations arising from this research is also provided (Table 4).

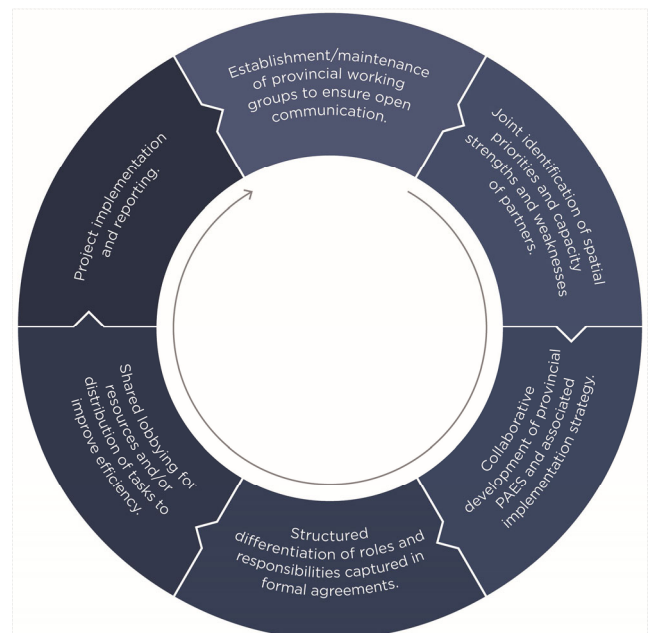


Figure 2. Logic model for enhancing collaboration among organisations involved in protected area expansion

DISCUSSION

Four major themes which emerged from the research as affecting biodiversity stewardship in South Africa were identified by key PLC stakeholders; namely: enhancing government–NGO collaboration, landowner partnerships, personnel capacity and financial opportunities. Due to the interactive and participatory nature of these research methods, many of the recommendations captured through this research have already been discussed amongst the relevant role players in South Africa and many are already being put into practice by different organisations. Examples of these include the establishment of Provincial Biodiversity Stewardship Reference Groups to support communication and collaboration, a Biodiversity

Stewardship Conference held in 2017 to promote high level political support, seeking pro-bono legal support, capacity development programmes for extension officers and developing an online platform for the distribution of training materials. For this reason the summary of recommendations provided distinguishes between initiatives currently being implemented by the sector and ideas for new initiatives developed through this research (Table 4).

Enhancing government–NGO collaboration

The Business Case (SANBI, 2017), NBSAP (Government of South Africa, 2015) and previous research (Pasquini et al., 2011) all suggest strengthening partnerships as a mechanism to enhance biodiversity stewardship. The

Table 3 Summary of support mechanisms and benefits available to private landowners

Management planning	Management interventions	Sustainable financing	Skills development & employment	Individual or intrinsic	Legal
Drafting environmental management plan for each site	Natural Resource Management activities	Facilitating landowner access to innovative biodiversity financing	Field ranger training and employment	Maintaining landowner's vision for their property	Securing conservation commitment through notarial deeds
Development of annual plans of operation	Pre-burn inspections, use of firebreaks and controlled burning	Municipal rates rebates / exemptions / exclusions	Fire and alien plant management training and sub-contracting these services	Landowner satisfaction of contributing to conservation	Safeguarding biodiversity value on the property
Annual review of management effectiveness (METT), to support landowners	Alien plant eradication	Biodiversity tax incentives	Small business establishment – ecotourism, natural resource management teams	Fulfilment of personal conservation values	Legal recognition through protected areas legislation
Ecological and biodiversity monitoring programmes.	Fencing (removal or erection as necessary).	Facilitating access to external donor funding.	Establishing micro-economies, including value added SMMEs, in wildlife economy or NRM	Social learning and networking opportunities.	
Grazing plans and rangeland/vegetation condition assessments	Supply of game Annual game censuses Access to the wildlife economy)	Facilitating access to government funding streams/ grants	Information and training day	Contributing to conservation of South Africa's cultural heritage	
Technical advice and support (GIS mapping, management planning, etc.)	Implementation of soil erosion control measures	Alignment with Biodiversity Economy Strategy and using this to leverage investment	Environmental awareness and education initiative	Maintaining biodiversity and natural resources for the benefit of future generations	
Implementation of ecological restoration					

Table 4. Summary of recommendations

Sections	Current initiatives	Research findings
Enhancing government–NGO collaboration	Establishment of provincial biodiversity stewardship reference groups to improve communication.	Documentation of the critical areas for improving collaboration.
	Structure partnerships along lines of differing technical strengths or different spatial priority areas.	Logic flow model designed to enhance collaboration by combining various aspects of the current work.
Landowner partnerships	Upskilling landowners, local community members or farm staff to assist with maintenance activities.	Monitoring and responding to landowners' attitude changes over the long-term.
	Focusing training initiatives and support on local champions.	Ensuring succession planning for new landowners of biodiversity stewardship sites.
	Communication programmes and events for landowners.	Creating and maintaining social networks to facilitate landowner capacity building.
Political support	Enhance the role of biodiversity stewardship projects in other large, landscape level government programmes.	Increase efforts to educate and empower municipalities with regard to the value of biodiversity stewardship.
	Conduct communication events with all levels of government and across different government departments.	Strengthen the relationships with other government departments.
Personnel capacity	Finalise the biodiversity stewardship guideline to ensure consistency of implementation.	Encourage mentoring, training or job shadowing among practitioners.
	Create an open access information database for all practitioners	Ensure adequate succession planning for staff and organisations implementing biodiversity stewardship at specific sites.
	Host annual learning events at both national and provincial levels, alongside other communications platforms such as quarterly national and provincial reference group meetings.	Finalise a legal guideline document to ensure consistency in implementation, including a note for biodiversity stewardship conveyancing for property attorneys.
Financial opportunities	Aligning existing capacity and funds and structuring roll out of projects to maximise efficiency in implementation.	Implementing a multi-phase funding approach including separate periods of scoping and investigation, negotiation and maintenance.
	Establish large-scale endowment funds for use across the sector.	Establishment of revolving trusts (one example thus far implemented in South Africa).
	Financing for conservation through payments for ecosystem services or investments in ecological infrastructure.	Establish a platform for reduced rates or pro-bono support from the legal sector.
	Investigate and leverage opportunities with other industries, including the game ranching or hunting sectors, Corporate Social Investment schemes, or mandatory government programmes such as B-BBEE.	Accessing pro-bono advertising, potentially utilising the unsold space in newspapers to reduce the costs of public participation.
	Strengthen and implement tax incentives to support landowners.	Standardise the implementation of property rebates for biodiversity stewardship sites.

results illustrate that whilst clarity of roles and responsibilities exists in most cases (1.4; 1.5; Table 1), this can be further refined to enhance outcomes. The logic model developed from this research takes partner organisations from initial engagement and improved communication, achieved through the establishment of provincial biodiversity stewardship reference groups, to joint identification of spatial priorities, formal differentiation of roles and responsibilities, and finally to well-structured partnerships captured in MOUs or other agreements (Figure 2). Currently, reference groups to promote communication exist in certain Provinces, however these are not yet standard practice across the country. In addition, although there has been

some degree of informal differentiation of roles and responsibilities and identification of spatial priorities among certain organisations, this has not been explicitly done across all regions. We therefore propose the logic model (Figure 2) as a formal process which could be implemented in all provinces to guide structured collaboration. This process may also be followed by similar groupings of organisations implementing PLC and PPA initiatives in other parts of the world. The respondents considered role differentiation as a critical point for enhancing collaboration and improving financial sustainability; however other studies have indicated that responsibilities must be allocated with the specific experience and skills sets of each partner in

mind (Pasquini et al., 2011). Partnerships may be structured along lines of differing technical strengths or across different spatial priority areas (3.1, Table 2). Collaborative spatial planning should be undertaken at multiple scales, both between government conservation agencies and NGOs, but also across government departments such as conservation and agricultural departments. NGOs and provincial government conservation agencies can act as potential bridging agents, bringing together different partners in the South African conservation landscape and thereby facilitating collaboration (Barendse et al., 2016). To further enhance collaboration, it is imperative that political support be obtained at multiple levels, including national, provincial, and district and local government agencies (1.1, Table 1). Ultimately, the efficiency of private and public land conservation may be improved through better integration (SANBI, 2017; Farley et al., 2017).

Landowner Partnerships

Private land conservation and the declaration of PPAs is not possible without the full support and trust of private landowners, be they community groups or commercial farmers (Knight et al., 2010). Respondents in this research indicated that conservation is sometimes considered to be in direct conflict with alternative land-uses (2.5, Table 1), and as such, there exists a clear need to address landowners' perceptions of biodiversity stewardship, and conservation in general (1.2, Table 1). Some practitioners felt that there is a lack of relevant benefits, such as financial incentives or environmental management projects, for landowners (4.3, Table 1); and the further development and communication of benefits for participants in biodiversity stewardship must be a priority. Other studies have acknowledged similar issues with regard to providing consistent incentives for landowners signing conservation agreements (Fitzsimons, 2015), and the need to clearly articulate these benefits (Drescher & Brenner, 2018). This research has generated a comprehensive list of the benefits available to, and support mechanisms for, private and communal landowners engaging in biodiversity stewardship in South Africa (Table 3).

Respondents also suggested that communication programmes regarding the positive outcomes for landowners involved in biodiversity stewardship should be developed at national and provincial levels, or in relation to specific target audiences such as commercial farmers or land reform beneficiaries (1.2, Table 1). Kusmanoff et al. (2016) found that messages from PLC initiatives in Australia were focused on the environmental benefits for a landowner. However,

communication programmes would do well to address the full range of value orientations, including egoistic, altruistic and environmental values, which may influence a landowner's behaviour (Selinske et al., 2015; Kusmanoff et al., 2016), as well as the full range of benefits available to participating landowners (Table 3). The long-term environmental management activities and support to landowners provided by extension officers are a major resource requirement of declared sites. Upskilling landowners, local community members or staff working on-site might allow for maintenance activities to be implemented by the landowners themselves, thereby potentially reducing the support required from government and guiding long-term sustainability of sites (3.4, Table 2) (Pasquini et al., 2009). Creating and maintaining social networks for biodiversity stewardship landowners could further enhance learning in the absence of extension officers and help strengthen the biodiversity stewardship landowner community of practice (Pasquini et al., 2009; Selinske et al., 2015; Selinske et al., 2016). This will not only contribute to their learning, but also to maintaining the satisfaction derived from an individual's involvement in biodiversity stewardship (Selinske et al., 2015; Selinske et al., 2016). Informal social networks amongst landowners and practitioners may be important in supporting the aims of PLC initiatives like biodiversity stewardship (Drescher & Brenner, 2018).

This research also suggested that succession planning, or rather the lack thereof, was a challenge for the sector (3.1, Table 1). Succession planning should be considered from both an organisational and landowner perspective. A history of landowner engagements, as documented by an organisation, would allow an extension officer to approach a specific property with full knowledge of previous attitudes and their potential suitability as a biodiversity stewardship site. Succession planning should also involve new landowners purchasing existing stewardship sites, or new family members who take on the responsibility of managing sites. Such planning may include educating new landowners regarding the activities and commitments which are expected of them, as owners of biodiversity stewardship sites, and the support which can be offered from conservation agencies. This notion of inter-generational stewardship has been recognised as a critical component for ensuring the long-term conservation gains from PLC initiatives are maintained (Selinske et al., 2017). It is important that landowners be sensitised to the long-term intent required for PPAs, as captured in the latest IUCN guidance defining PPAs (Stolton et al., 2014). Such long-term intent may require the involvement of multiple generations of landowners at a single site.



White rhinoceros are being conserved across both state and privately protected areas in South Africa © Dale Wright

Personnel Capacity

The government and conservation agency personnel directly involved in PLC projects and the declaration of PPAs are the cornerstone of such work. Their partnerships with landowners facilitate the establishment of protected areas and conservation areas (Fitzsimons et al., 2013). It is essential that personnel are adequately skilled and supported to undertake this important work. Extension officers working in biodiversity stewardship require a highly diverse skills set including, but not limited to: ecological knowledge, understanding of management interventions, knowledge of environmental legislation and legal procedures, socio-economic considerations, knowledge of agricultural practices and social skills such as negotiation, conflict resolution and leadership (3.3, Table 1) (G Mortimer pers comm). Rather than expecting all personnel to fully understand and apply every aspect of this diverse skill set, as is currently often the case, respondents suggested that online communication and information sharing platforms or websites should be created (4.5, Table 2). These platforms should house relevant knowledge and allow practitioners to access specific information as and when

required. They might also allow practitioners to post specific questions or issues on an open platform and receive guidance from others in the sector, thereby providing a networking and mentoring facility. The International Land Conservation Network (ILCN) fulfils a similar role at a global scale through their webinars and website (www.landconservationnetwork.org). Separate communication and networking platforms could be developed for practitioner and landowner communities of practice. Additionally, in order to bridge the potential skills gap, partnerships with other experts and practitioners may be utilised, with various skills being sought as and when required. The biodiversity stewardship community of practice could also look to developing accredited training programmes at graduate level, or identify relevant short courses, for both the technical and non-technical skills required.

Mentoring and training from colleagues was highlighted as potentially assisting in transferring skills among individuals or institutions. Formal training interventions are being undertaken periodically by the sector, but ongoing mentoring among colleagues may help to further improve skills and strengthen

implementation. Job shadowing and mentoring for new entrants to the sector would also allow for upskilling of biodiversity stewardship practitioners (Table 4). Participants suggested existing institutional or personal knowledge gained from years of experience should also be captured in practical learning materials (4.3, Table 2). These materials can subsequently be used in formal training sessions or through mentoring programmes. Platforms such as peer learning events, knowledge exchanges and mini-conferences will increase communication and enable social learning within the biodiversity stewardship community of practice (SANBI, 2017). These online materials, short courses and learning events should all form part of a standardised national toolbox (4.4, Table 2), freely available to all practitioners.

Financial Opportunities

A lack of funding for sustainable conservation programmes is one of the biggest stumbling blocks facing biodiversity conservation globally (Balmford et al., 2003; Waldron et al., 2013). As suggested by the responses from the national questionnaire, securing sustainable funding for permanent extension staff and the ongoing maintenance of sites are potentially the greatest challenges for biodiversity stewardship in South Africa (2.1, 3.2, Table 1). Previous studies have shown that landowners place particular importance on the extension service, which is provided as part of the maintenance function for declared PPAs (Selinske et al., 2015). These extension services are not possible without sufficient funding from well-resourced government and NGO stewardship programmes to provide experienced and suitably qualified personnel (2.2, 3.3, Table 1). In certain Provinces the provision of extension services is limited by a lack of resources, and it is therefore essential for the sector to develop innovative financing mechanisms.

These programmes may be supported through mixed income from national government, the private sector or alternative funding streams. Financing for conservation through payments for ecosystem services or investments in ecological infrastructure have not yet been fully realised in South Africa, but should be investigated as an additional avenue for achieving conservation (DEA, 2017). Utilising biodiversity offsets to both secure critical areas, and contribute to the management of existing or new sites could also be explored. It is important to note that whilst offsets may provide opportunities, they may also pose threats if not implemented correctly with the necessary safeguards (Maron et al., 2015).

Rather than depending solely on increasing traditional funding allocations for this work, the biodiversity stewardship sector could seek to better coordinate projects among multiple partners, to improve efficiency (e.g. improving government–NGO collaboration), eliminate duplicate efforts and redundancy, and potentially reduce costs through pro-bono provision of certain services. Legal costs remain a large part of the budget for NGOs implementing biodiversity stewardship programmes (2.4, Table 1); however these legal costs could be cut by establishing a platform for reduced rates or pro-bono support from the legal sector (4.2, Table 2; Table 4). Financing for the maintenance of sites may be secured through increasing the roll out of tax incentives to landowners, through increasing access to tax practitioners with the relevant skills and resources; a project currently being implemented in South Africa (Lapeyre & Laurans, 2016; DEA, 2017; Stevens, 2018).

The establishment of endowment funds specifically for biodiversity stewardship is also being considered (2.1, Table 2; Table 4). Centralised endowment funds could be co-created by multiple partners in the sector, and subsequently be drawn from by those same partners as the funds mature and disburse income. The establishment of revolving trusts which are maintained through the purchase and resale of land and subsequent investment of profits into the revolving fund has led to successful conservation outcomes in other parts of the world (Hardy et al., 2018a,b) and may have potential in South Africa (DEA, 2017).

CONCLUSION

We acknowledge that a shortcoming of this research is the missing perspective of the landowners engaged in biodiversity stewardship programmes. The challenges and opportunities which exist for landowners may very likely be different to those experienced by implementation agencies (Lute et al., 2017; Prado et al., 2018), and represent essential information required for advancing the implementation of biodiversity stewardship. Given previous research in South Africa regarding landowners' perspectives (Pasquini et al., 2009; Selinske et al., 2015), this research sought to expand our knowledge by focusing primarily on implementation agencies. Successful PPA and PLC programmes require both strong implementation agencies and motivated landowners (Fitzsimons et al., 2013); as such this research should be considered alongside the perspectives of landowners (e.g. Selinske et al., 2015) to generate a broader understanding of the challenges and opportunities for the biodiversity stewardship initiative as a whole.

The staggering figure of 68 per cent of all of South Africa's protected areas, declared between 2008-2016, being declared PPAs through biodiversity stewardship, coupled with the significant cost reduction (SANBI, 2017), is evidence enough that biodiversity stewardship should be embraced by the state and private sectors. The past decade of implementing biodiversity stewardship has produced important successes, lessons learned and highlighted a number of challenges. This research was timely in engaging the South African biodiversity stewardship community of practice during a period in which it is thinking critically about the key challenges. The research here adds to the growing body of work highlighting the challenges and opportunities to PLC and PPA schemes, not only in South Africa (Pasquini et al., 2009; Selinske et al., 2015) but in many parts of the world (e.g. Rissman & Sayre, 2012; Fitzsimons & Carr, 2014; Scrimgeour et al., 2017; Prado et al., 2018). This research further aims to provide a framework and methodology for other practitioners wishing to undertake a similar high-level evaluation of the organisations implementing PLC or PPA initiatives in their own countries. PLC and PPA initiatives must remain flexible in order to reach a wider audience of private landowners and respond to changing socio-economic conditions (Selinske et al., 2016; Drescher & Brenner, 2018). This research is intended to help facilitate such flexibility in the South African biodiversity stewardship initiative.

SUPPLEMENTARY ONLINE MATERIAL

Appendix 1 Biodiversity Stewardship Capacity Questionnaire

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RESUMEN

La pérdida y degradación del hábitat se encuentran entre las amenazas más apremiantes que se ciernen sobre la biodiversidad mundial. El aumento de las redes tanto de áreas protegidas como de áreas de conservación constituye un mecanismo importante para conservar la biodiversidad y mejorar la gestión de la tierra. La conservación privada de tierras y el establecimiento de áreas protegidas privadas se ha convertido en una herramienta eficaz en función de los costos para la ampliación de las áreas de conservación. Sin embargo, las instituciones públicas y privadas tienen una capacidad financiera y humana limitada para llevar a cabo este trabajo. La presente investigación examinó los desafíos que enfrentan los organismos de conservación que implementan la iniciativa relacionada con la gestión racional de la biodiversidad en Sudáfrica y las oportunidades que pueden aprovecharse para fortalecer aún más estas organizaciones. La investigación se dirigió a los profesionales e incluyó una serie de discusiones de grupos focales y un cuestionario en línea. Las recomendaciones que surgieron de esta investigación están estructuradas en cuatro temas principales: mejorar la colaboración gobierno-ONG; asociaciones de propietarios de tierras; capacidad del personal; y oportunidades financieras. Se presenta un modelo lógico para orientar la colaboración gobierno-ONG, junto con una tipología de los beneficios y mecanismos de apoyo disponibles para los propietarios de tierras involucrados en la gestión racional de la biodiversidad. Las iniciativas relacionadas con la conservación privada de tierras deben ser flexibles para poder adaptarse a las condiciones socioeconómicas cambiantes. Esta investigación pretende ayudar a facilitar dicha flexibilidad en la conservación privada de tierras y en los programas de áreas protegidas privadas.

RÉSUMÉ

La perte et la dégradation de l'habitat comptent parmi les menaces les plus urgentes qui pèsent sur la biodiversité mondiale. L'élargissement des réseaux d'aires protégées et d'aires de conservation constitue un dispositif clef pour la préservation de la diversité biologique et pour l'amélioration de la gestion des terres. Dans ce contexte, la conservation de terres privées ainsi que la création d'aires protégées privées représentent désormais des outils efficaces et économiques pour assurer l'extension du domaine de conservation. Cependant, les institutions publiques et privées souffrent de capacités financières et humaines limitées pour accomplir ce travail. Nous avons étudié les défis auxquels sont confrontés les organismes de conservation en Afrique du Sud pour élaborer leurs initiatives de gestion de la biodiversité et les opportunités qui pourraient être exploitées pour renforcer ces organisations. Cette enquête s'adresse aux opérationnels de la conservation, et comprend une série de discussions de groupe et un questionnaire en ligne. Les recommandations qui en découlent s'articulent autour de quatre thèmes principaux : le renforcement de la collaboration entre le gouvernement et les ONG ; les partenariats avec des propriétaires fonciers ; la capacité en personnel ; et des opportunités financières. Nous présentons un modèle logique visant à guider la collaboration gouvernement-ONG, ainsi qu'une typologie des avantages et des mécanismes de soutien disponibles pour les propriétaires fonciers impliqués dans la gestion de la biodiversité. Les activités de conservation menées sur les terres privées doivent rester flexibles afin de répondre aux conditions socio-économiques changeantes. Cette analyse a pour but de d'encourager la souplesse et l'agilité dans les programmes de conservation de terres privées et d'aires protégées privées.



DEVELOPING LEARNING LANDSCAPE PARTNERSHIPS: WHY AND HOW TO WORK WITH PROTECTED AREA MANAGERS

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ABSTRACT

There are many calls for more effective science-policy interaction and knowledge exchange in order to tackle persistent conservation problems; however, more clarity is needed surrounding the roles and practices involved. To address this challenge, we present the outcomes of an iterative, transdisciplinary process between researchers and protected area managers, to identify good practice in the development of what we call 'learning landscape partnerships'. This was achieved by a series of deliberative workshops, informed by the literature, to consolidate pan-European experience of those who manage and study protected areas. The resultant 'learning landscape partnership' model highlights the key role of a 'neglected actor' in such partnerships - the protected area manager. Critically, protected area managers can act as intermediaries in interpreting science for use in conservation. However, this requires the recognition of: the boundary spanning work of individual researchers and protected area managers; the need for support and encouragement by their respective organisations; and the multi-dimensional institutional setting by which the relationship building occurs. Working with protected area managers therefore requires transformation in these three areas. Transformation is rarely straightforward but may be required to respond to the urgent conservation challenges facing our most valuable landscapes.

Key words: Protected areas; transdisciplinarity; environmental governance; stakeholders; boundary organisations

INTRODUCTION

Despite considerable scientific research seeking to address complex, environmental problems, including habitat and biodiversity loss, many of these problems persist (cf. Duckett et al., 2016; Beumer & Martens, 2013). An often repeated demand is for more effective science-policy interactions (Young et al., 2014; Reed et al., 2014). There is a need to focus science on the implementation of policies and plans; shifting from the

goal of seeking new 'facts' to focus on supporting environmental problem solving (McKinley et al., 2013; Raymond et al., 2010; Gaziulusoy & Boyle, 2013; Roux et al. 2006). Bertuol-Garcia et al., (2018) argue that ecological science has been slow to recognise the need to move from uni-directional to dialogical processes to close the science-practice gap. The Convention on Biological Diversity encourages interactions between those involved with biodiversity issues, including

scientists, field managers and policy makers (Markussen et al., 2005 in Chandra & Idrisova, 2011). As Nesshöver and colleagues explain, the complexity of biodiversity issues and range of critical questions to be addressed “require a better articulation and mutual understanding between knowledge producers (including scientists) and knowledge users” (Nesshöver et al., 2016: 1209).

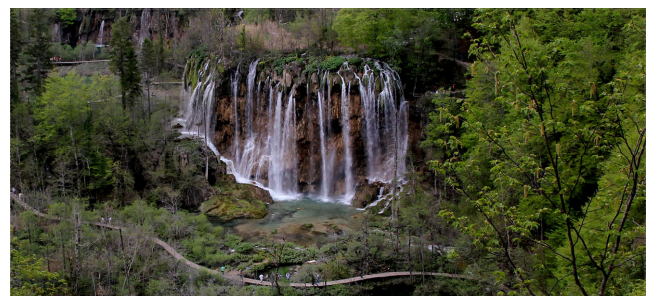
Protected area (PA) management organisations are important actors in landscape scale conservation interventions. The International Union for Conservation of Nature (IUCN) defines ‘protected areas’ as a “clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values” (Dudley, 2008)¹. We use this definition to represent the range of regional, natural, national parks, biosphere reserves, and other designated areas that are landscape scale units supporting multi-functional land use (cf. Scolozzi et al., 2014). PA management is broad in scope, covering a whole spectrum of activities including understanding human behaviour, implementing policy directives, and managing for biodiversity, therefore requiring exchange between researchers (from social and natural science disciplines) and managers. The PA management organisations often must combine statutory responsibilities with supporting market or voluntary-based practices. Given these multiple functions, managers frequently act as integrators of scientific knowledge and management practice (cf. Raymond et al., 2010; Armitage et al., 2011). Furthermore, PA organisations often have a remit to act as knowledge intermediaries, and to promote better understanding of the natural environment and its benefits to human well-being (cf. Moll & Zander, 2013; Spoelstra et al., 2013; Smit et al., 2017).

Whilst PA management organisations (and the individuals who work for them) are required to meet certain environmental objectives, their role as knowledge users was little discussed until recently (see Bertuol-Garcia et al., 2017). Research too often fails to tap into managers’ scientific, administrative and lay knowledge, despite known benefits (Irvine et al., 2009; Roux et al., 2015). Indeed, Goulson and colleagues describe “a yawning gulf between the research consensus and practical on-the-ground habitat management” (2011:4) (see also Courter, 2012; Chandra & Idrisova, 2011). This gap between scientists and decision makers with regard to communication of ecological knowledge (Shackleton et al., 2009; Toomey

et al., 2017), inhibits the translation of information, knowledge or research findings into tasks and actions to achieve defined goals (i.e., ‘knowledge utilisation’; Crona & Parker, 2012; Chandra & Idrisova, 2011; Braunisch et al., 2012; Cook et al., 2013).

What is less clear is who should translate scientific insights into management actions (cf. Goulson et al., 2011)? Exhortations to ensure that science has more ‘impact’ fail to explain who scientists are seeking to share their findings with, how these findings will inform management and critically, who will implement the resulting management actions. Our literature search found very few explicit references to science-management interactions; as opposed to science-policy or science-community engagement; particularly with reference to protected areas (see Cook et al., 2012 for an exception). Therefore, in this paper we explore the role of PA managers (as individuals) and their organisations, as intermediaries between science and PA management. We argue that PA managers are neglected, but important, partners with whom researchers should work and PA management organisations are a neglected example of a boundary organisation that can bridge ‘science’, ‘policy’ and practice (Franks, 2010). An important distinction emerges regarding the individual PA manager and the PA management organisation. This paper focusses on the development of a good practice model for research - PA manager partnerships, drawing attention to the role of inter-personal relationships, organisational support and the wider governance context in which these partnerships are based.

Thus, the paper presents the outcomes of an iterative, transdisciplinary process between researchers and PA managers, to identify a model of good practice in the development of what we call ‘learning landscape partnerships’². The Supplementary Online Material details research initiation by the EUROPARC Federation (EUROPARC)³ and further understandings of the transdisciplinary approach adopted. The paper proceeds with an outline of the methodology and presentation of



Plitvice National Park in Croatia: managing visitor flows requires cooperation between science and management. © Michael Huber

workshop results, followed by a discussion of these findings considering our focus on inter-personal relationships, organisational context, and boundary/bridging work, plus conclusions relevant for all involved in PA management.

METHODOLOGY

In alignment with transdisciplinary research protocols (Lang et al., 2012), this research adopted a collaborative research design, from problem definition to methodological design, data collection, analysis and interpretation. EUROPARC wished to facilitate in-depth discussions and social learning amongst individuals with experience of interactions between science and PA management, and to generate stronger research- PA management relationships. Figure 1 indicates the main steps of the methodological process, which centred on a series of participatory workshops with participants from conservation science and PA management across Europe. An iterative process which is open to continuous collaborative revision by the research and non-scientific participants can contribute to more accurate decision-making and research outputs (cf. Glass et al., 2013). In this regard, each workshop process was informed by the preceding workshop or existing scientific literature, in order to develop a model

of good practice. This section provides further detail regarding the different stages of the methodological process, including the literature review, workshop phases, and reporting process.

Development of a 'good practice' model

Following formation of the initial collaborative research team (lead and second author, in conjunction with EUROPARC representatives) who agreed on the problem focus and research questions, a systematic literature review was undertaken. Defined combinations of keywords (Table 1) were used to identify relevant scientific literature (about 45 key papers) across a number of online libraries⁴.

Table 1. Search terms for systematic literature review

Topic		Key word
Environmental Management	AND	Social Learning
Natural Resource Management		Partnerships
Protected Area Management		Knowledge Exchange
Conservation		Knowledge Transfer
		Transdisciplinary
		Action Research

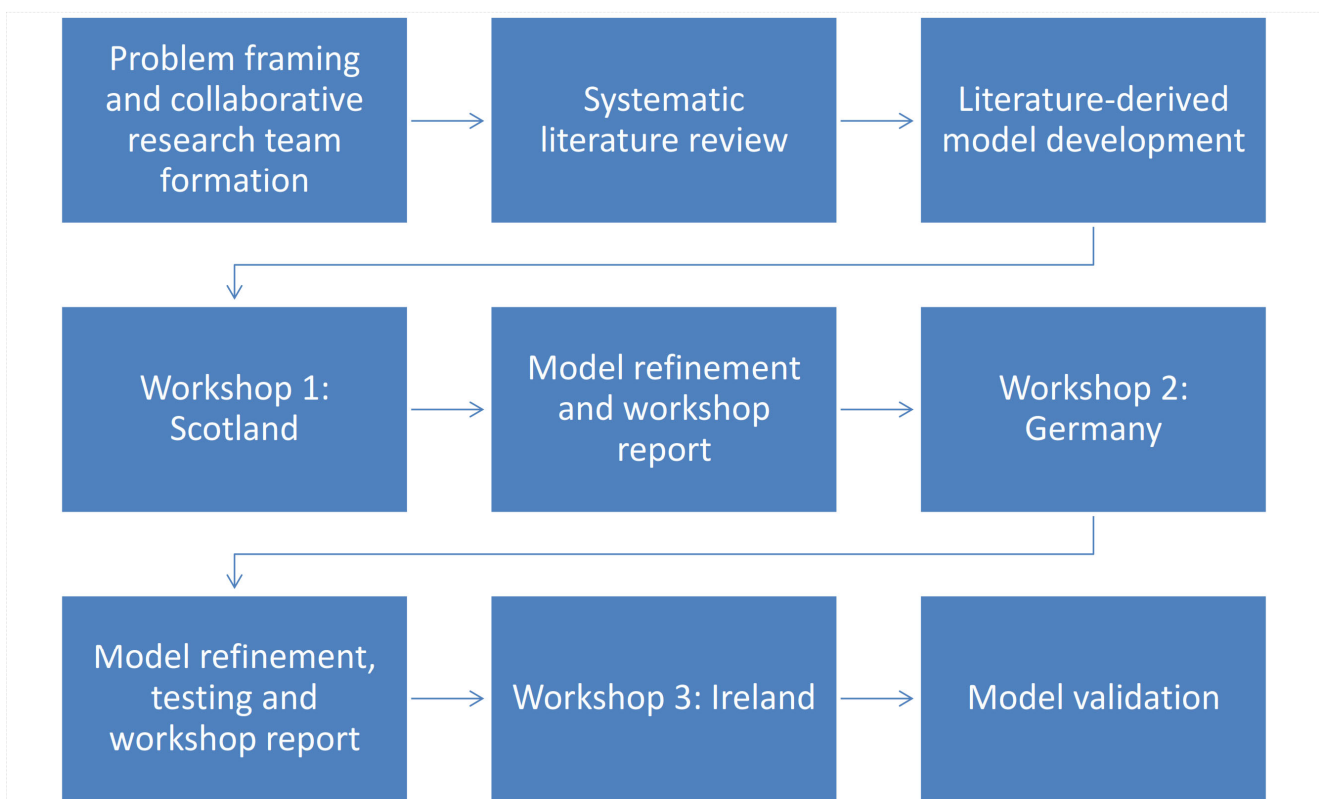


Figure 1. Overview of methodology steps

A schematic model (see Figure 2) summarised diagrammatically the lessons derived from the literature review for creating 'Learning Landscape Partnerships', i.e. a good practice model for science- PA management interactions. This provided the basis for discussion in the first workshop (held in Scotland). Unlike Figure 3, Figure 2 was not co-produced with the workshop participants.

Data collection

A series of three progressive workshops were held to discuss the benefits, challenges, and practicalities of researcher- PA manager partnerships, and improve the 'good practice' model from the literature (Figure 2). A purposive sample was used to identify and recruit individuals, based on their background and expertise related to protected areas, and representing different research institutions, and PA management across Europe. A total of 28 participants originated from University faculties and national parks in Spain, Norway, Italy, Hungary, Austria, Germany, the Czech Republic, Slovenia, and Scotland⁵. All 28 participants acted in an individual and anonymous capacity. The first two workshops were in held Scotland (April 2014) and Germany (September 2014). Five participants who attended the Scottish workshop also travelled to Germany for the second workshop (including the EUROPARC representative), contributing to the integration of knowledge and maintaining the transdisciplinary dialogue. Participants in the final workshop in Ireland (October 2014) were self-selected, because this workshop was a voluntary option for delegates attending the EUROPARC annual conference. Each successive workshop refined the model, building on the outputs of the previous workshop (see Figure 1). The participants in Ireland agreed with the components and structure of Model v.3, co-constructed during the German workshop (see Figure 3).

Each workshop was introduced by the facilitators and EUROPARC representative, who described the rationale and aims of the project, and workshop. The workshop activities included individual participant introductions and short presentations, describing their 'top tips' for developing effective interaction and knowledge exchange between PA management and research. The critical activity of each workshop was participant-led development, testing, and refinement of the 'good practice' model. Evidence is also drawn from supporting activities, such as the role-playing games undertaken during the German workshop. This exercise generated a list of factors that both support and inhibit effective interaction within a 'learning landscape partnership'.



Figure 2. Draft model summarising the key factors required for Learning Landscape Partnerships (literature derived as a starting point for the Scottish Workshop; see Blackstock et al., 2014)]

Each workshop ended with a plenary discussion, summarising the key messages of the workshop, and the next steps of the project overall, as well as the completion of participant evaluations forms (see Figure 1). The evaluation form also sought to capture key lessons that the participants were taking from the workshops, as indicators of social learning (cf. McKee et al., 2015).

Data analysis

Workshop notes were analysed qualitatively through thematic coding (Spencer et al., 2003). Following the analytical ladder (cf. Spencer et al., 2003), all data were inductively coded, with further analysis conducted to explore the concepts upon which this paper focuses, namely: partnerships, organisational contexts; bridging and boundary organisations. This analysis was peer-validated by the participants, and participant-verified reports were published on the project webpage⁶. All outputs can therefore be considered as co-constructed, corresponding with the final phase of Lang et al.'s (2012) conceptual model for transdisciplinary processes. All quotes presented in the following section are direct speech or post-it notes written by the participants.

RESULTS

The co-construction of the revised model was perceived as a positive experience, as recorded in the workshop evaluation forms. Participants highlighted the generation of new contacts, the identification of research gaps from the perspective of PA managers, and

the opportunity to learn from multiple viewpoints as the main benefits of their participation. Indeed, the range of expectations, assumptions, and understandings brought by the participants formed the basis for complexity of the final ‘model’ for learning landscapes partnerships (see Figure 3).

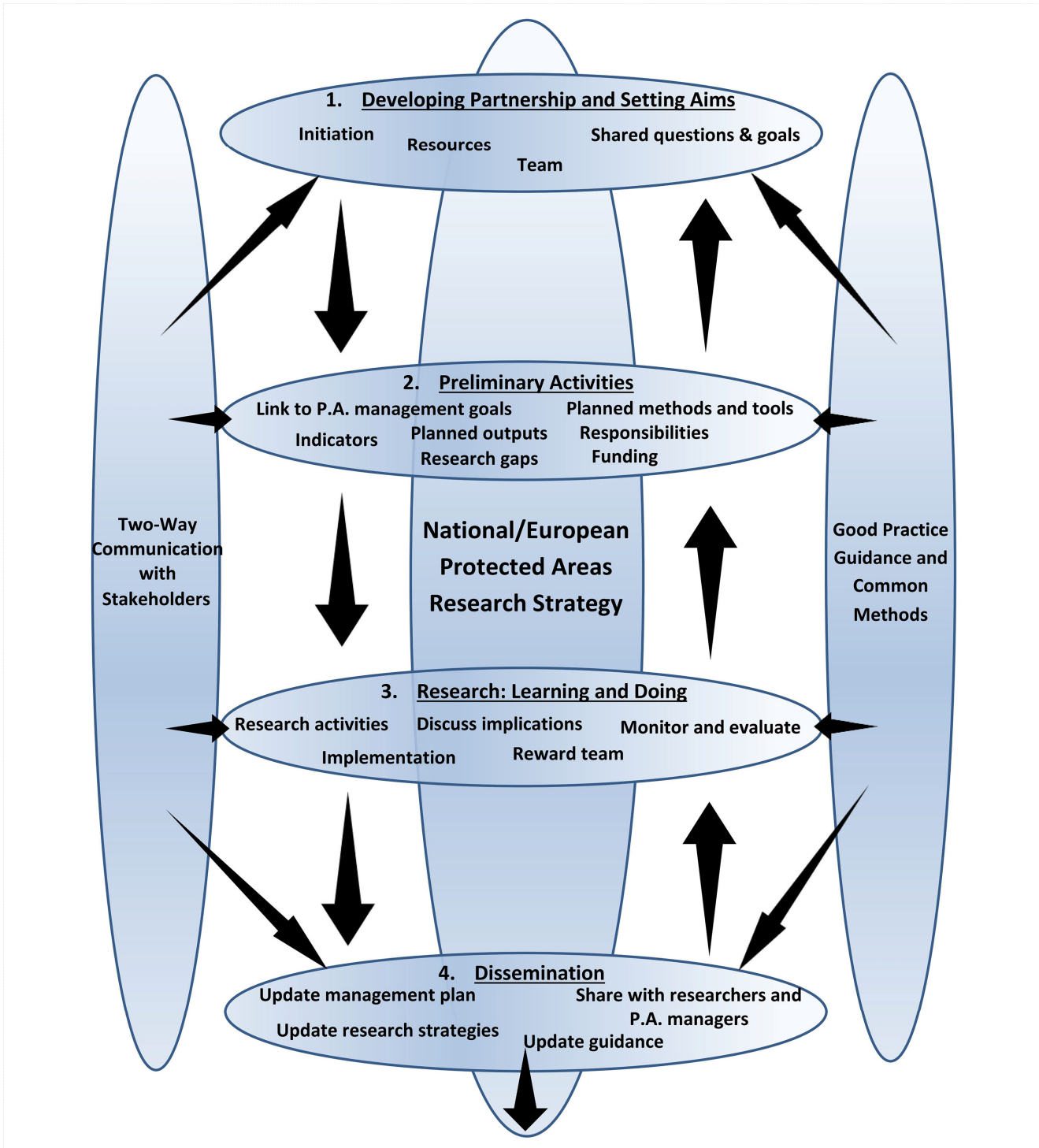


Figure 3. Model v3, illustrating the process of developing learning landscapes partnerships (German workshop)

The model describes the range of aspects underpinning each state of a partnership process, including initial development and aim-setting, early stage partnership activities, main activities such as research processes, and finally dissemination, incorporating monitoring and evaluation. Throughout these stages, two key principles are inter-related and support partnership success: (i) two-way communication with stakeholders; and (ii) good practice guidance and common methods. The model is sequential, with each step aiming to contribute to the outcome of 'better' PA management. However, depending on the previous history of PA management-research partnerships and the context for initiating this partnership, it may be possible to enter the model at different stages (i.e. previous partnerships can be built on and institutional support may be in place). Participants discussed whether the co-produced model represented the ideal (i.e. good practice partnership working between PA management and research) or a synthesis of past experience. It is interesting to note the complexity of the co-produced model of good practice (Figure 3) compared to our original distillation of good practice from the literature (see Figure 2). The complexity may be daunting, but it conveys the reality of transdisciplinary working between PA managers and researchers, within their institutional settings (see also Cilliers et al., 2013). We now draw out

three aspects of our findings that we believe make a contribution to the debate on how to bridge the science-management gap: inter-personal boundary work; intra- and inter-organisational boundary and bridging; and the need for bridging between protected area and wider governance processes.

Inter-personal boundary work between Protected Area Managers and Researchers

Participants who co-produced the model of good practice believed that the PA manager-research team were responsible for implementing the model at every stage (see Figure 3), suggesting that they felt individuals needed to be boundary spanners. Two aspects of such boundary work stood out – common roles and hybrid identities. Participants identified some common roles for both PA managers and researchers, namely around producing shared research questions, setting up teams, applying for funding and research permissions, making sense of the data, and considering what the information means for their practice. For example, one person role-playing a researcher requested to “meet with park staff to discuss joint proposal”, whilst another role-playing a PA manager suggested: “[asking] social scientists to identify stakeholders for the partnership”.

Boundary work was identified between PA managers and researchers; within and between the respective organisations in which people worked; and to manage wider institutional drivers and actors. Indeed, many of the workshop participants confounded the neat categories of ‘researcher’ or ‘PA manager’. Several played multiple roles e.g. as both University lecturers and national park employees, or researchers with long-term and close professional relationships with PA managers. Most PA managers had academic qualifications, including PhDs. The ‘multiple hats’ metaphorically worn by these individuals helped them to understand both roles (i.e. overcoming epistemological differences) and enable positive collaboration. These findings draw attention to the role of bridging organisations and the dynamic multi-level and polycentric knowledge networks in which PA manager-researcher relationships are situated. Our data also reflected some common themes in protected area literature: mutual benefits but also challenges around shared priorities (Underwood, 1998, Rose et al., 2016). For example, working with PA managers, researchers gain access to data, which in turn supports the work of PA management organisations, e.g. the enforcement of protection zones for species and habitats:

We now have the knowledge to improve the participation of researchers in managing [protected areas]...This improvement will lead to better conservation in practice.



Workshop participants discuss the benefits, challenges, and practicalities of researcher- PA manager partnerships© Kirsty Blackstock

The participants described the difficulty in agreeing shared priorities as a challenge to partnership working between PA management and research. Scientists often have different motivations for research compared to PA managers. PA managers told stories of researchers who changed their focus or failed to engage in ways that allowed their results to have an impact on management. The workshop discussions also implied that identifying shared goals was an ongoing and iterative process; thus:

Identifying priorities and goals is not a discrete step to take once but needs constant communication to keep people informed of progress and to ensure that the shared priorities are still valid.

This implies a long-term partnership approach is important, but there are challenges that arise around temporal mismatches in establishing shared priorities in different organisations.

Within partnership working there is also a perceived risk regarding shared priorities, as these may not correspond with the PA organisational objectives and/or the findings may not support the statutory management regimes that the PA manager is required to implement. Indeed, PA manager participants spoke about the risks of engaging closely in research, when results may threaten the status of a protected area or implicitly critique a PA manager. Research participants noted that publicising data can be problematic, because it can be mis-used in management decisions (e.g. when a conservation activity looks like it is not ‘cost-effective’ and is therefore discontinued). These real-life examples provide a sobering counterbalance to the literature on the benefits of transdisciplinary working.

Whilst inter-personal relationships are important in the literature (Tinch et al., 2018), we were intrigued by the emphasis on the individual researcher or PA manager’s commitment to the partnership process, which became a dominant theme of all three workshop discussions and). As summarised:

Interpersonal relationships are the ‘oil’ for the machine: informal, long-term relationships are essential to support day-to-day management decisions. Active cooperation is required, which takes time and commitment. Person-to-person links are essential elements of a long-term partnership – one can’t link to a ‘community’ or a ‘region’.

A number of negative experiences were used to explain the importance of commitment. Negative experiences were shared by the PA managers recalling researchers who were extractive, failing to thank PA managers for their time and input, and/or not feeding back findings in a useful format, with guidance for management. The role-playing game brought out some heartfelt examples,

such as: “[researchers that are] too busy writing scientific papers to share and explain the results with the protected area manager”. These findings demonstrate the emotional and experiential aspects of closing the science-management gap and the demands placed on individuals who boundary-span.

One of the striking findings from the workshop discussions was the emphasis put on ‘preliminary activities’; note that in Figure 3, research does not actually begin until the third stage of the ‘model’. Participants in Scotland also emphasised the ‘ground work’ necessary for partnership development, including the need to agree the type of partnership, as well as ensuring shared goals and benefits, from the outset of partnership development. The participants in Germany and Ireland reiterated the important stages of partnership initiation as well as drawing our attention to the extent of preliminary activities necessary prior to stages of ‘research, learning and doing’. This requires both commitment by individuals, to undertake successful boundary spanning work, but also the support of their organisations and the wider institutional settings .

Organisational Support

Participants noted that often time and money are needed to engage the ‘right’ people and agree priorities, before data can be collected and evidence used within a partnership. PA organisations often already lack resources, they recognise the need to create partnerships to pool resources and build capacity (Michaels et al., 1999), but they do not have sufficient resource to build the partnerships themselves. The focus on experience showed that participants recognised that partnership building takes time, but such effort is not always recognised (e.g. by senior management in both PA and research organisations). Whilst time commitment is recognised in the literature (cf. Andrade et al., 2014; Tinch et al., 2018), our findings drew attention to the ‘key fight’ by participants with their organisations for time for partnership-building, and, crucially, partnership maintenance (e.g. attending committee meetings or workshops) to be funded. Indeed, several participants attended the German workshop during their annual leave, because it was not supported by their organisation’s funding model. This lack of support threatens partnerships; whereas partnership working should be ‘part of job descriptions’ and incentivised.

The wider literature on partnership working (cf. Gonzalo-Turpin et al., 2008) notes the importance of the ‘right’ participant. Our participants linked this discourse with organisational incentives:

Institutional processes and incentives can ensure we get the 'right' people...For partnership to work it needs support at the 'right' (i.e. senior) level.

Therefore, despite the importance of inter-personal relationships, many participants highlighted the need for formal partnership agreements. Participants recommended the signing of an agreement between PA and research organisations, detailing the obligations of both during, and subsequent to, the partnership process, covering issues like shared intellectual property rights. This is common practice when considering working with indigenous and traditional knowledge in PA conservation (e.g. in Australia (Hill et al., 2012); see also Posey et al., 1995) but less common in Europe. These agreements would help to ensure students and researchers thank key research informants and return research findings to PA managers for their use. The importance of formalising research partnerships is not apparent from our review of the conservation literature (see Cook et al., 2013 for an exception), but was clearly identified as good practice by participants.

Participants identified important contextual differences that influence the degree of control that PA organisations could have over researchers. In some instances, the PA organisations were able to issue licences for research data collection; and this allowed them to try to lever more benefits for their organisation⁷. In other countries, PA organisations do not know what research is being conducted within their boundaries and have a much harder time identifying, let alone working with, these potential partners. Again, this point is not often highlighted in the literature, but could help understand differences in the ability for PA organisations to control and direct applied research in their territories.

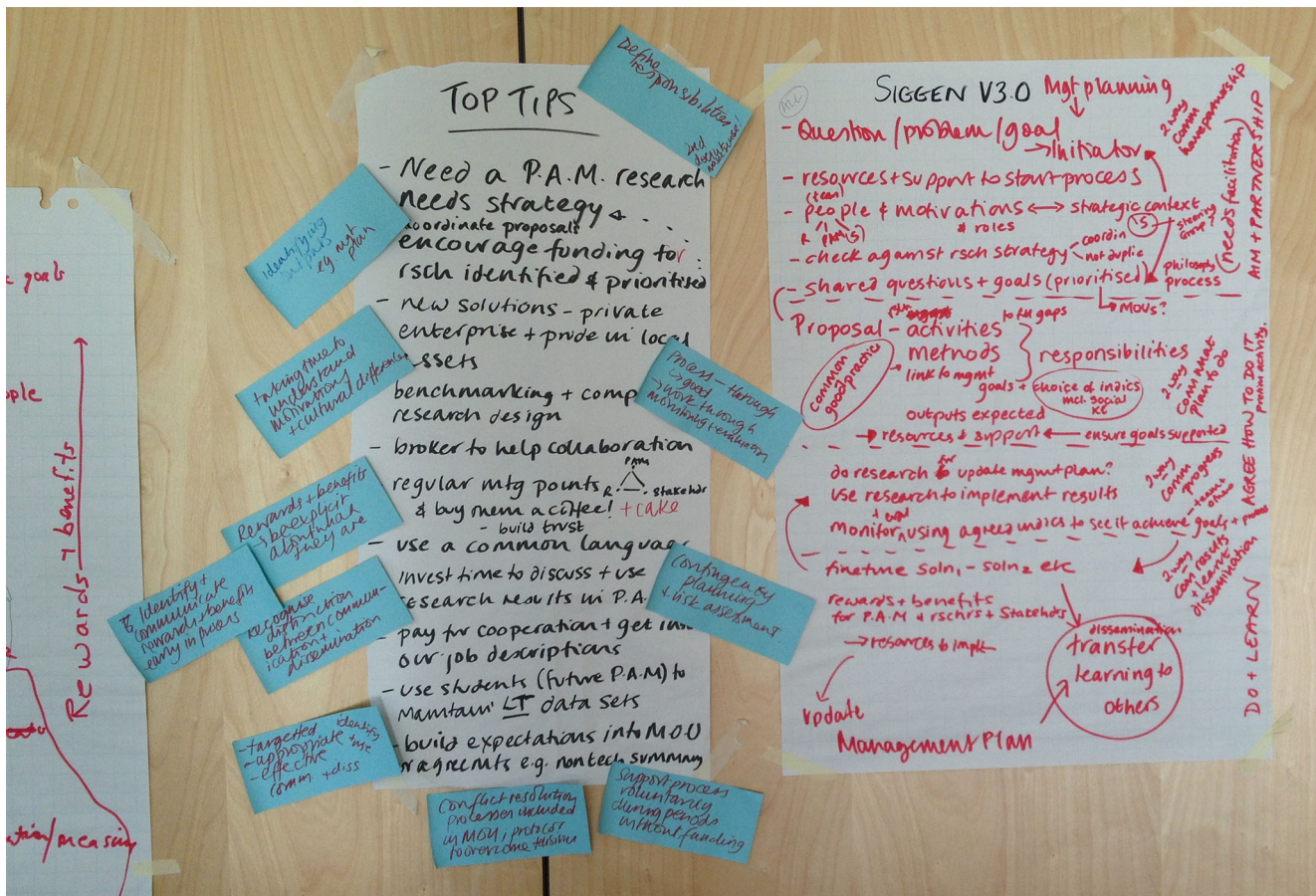
Participants also felt research- PA management partnerships required both a long-term repository of formally-recorded information alongside informal relationships that support the interpretation and utilisation of this information. Whilst interpersonal relationships were important, but the benefits of these partnerships need to persist beyond the individuals involved, given that these individuals may leave their organisations. Researchers and PA managers therefore also must invest time in sharing and archiving knowledge within their own organisations, to extend the reach of the insights generated by these partnerships. This was flagged up by the role-playing exercise, whereby a PA manager explained that: "if impressed with the results; will present and spread the results with other protected area colleagues". Furthermore, this insight demonstrates that researchers must be aware of

the organisational structures and cultures influencing knowledge use (e.g. PA objectives); rather than solely providing more science to PA managers. These insights, around the need for formal partnership agreements, ability to regulate research, and setting up formal data management processes, goes beyond individual organisational support from PA and research organisations, necessary as this is, and draws attention to other actors involved in PA governance.

Multi-level Bridging and Boundary Work

The findings above identify the need for bridging organisations which ensure that the insights from individual partnerships are not lost once these partnerships end. Indeed, the participants identified the importance of how and when to 'close-down' partnerships as part of the first stage of the 'model' (see Figure 3 and associated guidance in McKee et al., 2014) – something rarely discussed in partnership or PA literature. Of importance was the need to ensure that insights from a prior partnership fed into general guidance for others to use in their PA management. As well as benefits to their own organisations, participants felt that partnerships provide an accessible route to existing networks, therefore avoid replication of research between protected areas and contributing to resource efficiencies. Thus, the right-hand column of Figure 3 requires bridging organisations (e.g. membership organisations such as EUROPARC) to help the model to function.

The Scottish workshop participants questioned how best to interlink new and existing partnerships, to ensure that they have an enduring legacy. This point was further elaborated in Germany when participants highlighted the potential role for bridging organisations such as EUROPARC, to exchange information and develop links between researchers and PA managers. This was confirmed in Ireland, when the workshop discussions affirmed the need for long-term and large-scale PA management and research partnerships, at the EU level. Indeed, this workshop ended with a proposal to EUROPARC to set up a working group to link research and PA management at the European level, working in conjunction with the European Commission. More generally, the action role-play game (as described in Section 2.2) identified several options for bridging organisations to support learning landscape partnerships. For example, NGOs could "review inputs and outputs" and use these to "advise policy makers and policy development/legislation on new viewpoints on protected area management". Research funding organisations, such as the European Commission need to recognise the upfront costs of partnership working;



The co-construction of a revised model of developing ‘learning landscape partnerships’ at a workshop at Siggen, Germany © Kirsty Blackstock

but could “continue to make money available to support a platform on scientific research in protected areas”. However, bridging organisations can also impede partnership working, as illustrated in the role-play game “in the case of projects not cooperating – [NGO] initiates international control of their proposals, with financial and other consequences”. Funders could also enforce financial penalties e.g. “If tasks are not reached in project, request money is returned (e.g. even if provided a year ago)”. Bridging organisations, through their linking and sharing activities, can make learning landscape partnerships both more effective and more efficient in terms of their use of scarce funding.

Participants at every workshop also highlighted the importance of communicating with ‘key supporters’ throughout the process. Therefore, boundary work in these partnerships does not only involve the PA managers and researchers themselves but requires managing the influence of a wider set of stakeholders (see the left-hand column of Figure 3). The participants highlighted the need to understand the influence of other actors in the PA management ‘system’, including

auditors, PA management board members, journalists, and government agencies. These actors could enable the learning landscape partnerships through supportive actions. For example, government agencies, in the role-play exercise, could “provide official statistical data beyond protected area, providing regional context”; a policy maker could “provide credibility to the partnership by providing governmental approval”, and a journalist can help to disseminate the findings or “write an article on the benefits of National Parks to society”. However, the participants also provided examples where these key ‘supporters’ created difficulties for the partnerships. For example, government agencies could “ignore or not participate in project because it is not in their scope of work,” and politicians could “pass a new policy putting solar panels and wind turbines all over the protected areas, as economic growth is more important than biodiversity”.

Participants were mindful of the need for local residents and land managers to understand and support PA management, and to be informed of, if not engaged in, PA research projects. In the action role-playing game,

participants hoped that local residents would “become members of partnership stakeholder group”. The participants in Germany in particular, repeatedly drew attention to the multi-faceted aspects of communication and relationship maintenance involved. It was clear from their examples that learning landscape partnerships had to consider the potential preferences and reactions of these local stakeholders to the research undertaken. The influence of non-engaged stakeholders is not well discussed in the transdisciplinary literature. Once again, novel and nuanced insights on working with PA managers were gained from listening to their practical experiences.

DISCUSSION AND CONCLUSION

Our findings suggest that PA managers offer an important, unique, and as yet neglected, resource in linking research and PA management. The evidence from participants is that where such partnerships exist, it is much easier for research to have an impact on the management of protected areas. However, successful and long-term research partnerships with PA managers and management organisations are not (yet) common (Bertuol-Garcia et al., 2018). Change is required on several fronts – in terms of the inter-personal interactions between researchers and PA managers; in terms of the support and encouragement provided by their organisations; and in the boundary and bridging work required to support these partnerships through time and across governance levels. This focus on boundary spanning reflects the growing interest in translational ecology and resonates with the findings of Safford et al., (2017) who also found that interpersonal skills, organisational support and information support tools were central to linking knowledge to action.

The findings suggest that PA managers can play three main roles in getting research into practice. Firstly, they, themselves, can use scientific findings to enhance current PA management practices. However, their agency may be limited if their own colleagues, managers, or political systems are not amenable to change, echoing Hegger et al. 2012. Secondly, PA managers can integrate issues and stakeholders’ views through their responsibilities for multi-functional and multi-owner landscapes, helping disciplinary researchers to become more aware of the context within which their findings might be used (Blackstock et al., 2011). Thirdly, PA managers can act as intermediaries in translating science for use in conservation management (Goulson et al., 2011; Spoelstra, 2013, Smit et al., 2017). This may be through challenging their scientific partners to explain themselves more clearly; or helping with broader dissemination to the

stakeholders in their areas. Often PA managers may be seen as more ‘grounded’ than academics; however, the research findings of academic partners can provide credibility. Therefore, researchers and PA managers have complementary but distinct roles in these partnerships. This finding from Europe echoes findings from other protected area contexts such as Africa (Moll and Zander, 2013; Shackleton et al., 2009) and Oceania (Cvitanovic et al., 2015).

It is therefore suggested that the answer to Goulson et al.’s (2011) question about ‘who’ should translate science into conservation action is researchers and PA managers working together. Our research goes beyond the ‘who’ to explore the ‘how’; building on other endeavours in the same vein (Roux et al., 2015; Cook et al., 2013) from across Europe (Risvoll et al., 2014) to throughout other protected area contexts (Cvitanovic et al., 2015). Our findings suggest that whilst difficult to set up and sustain, so-called ‘learning landscape partnerships’ offer such an approach. The model of good practice (Figure 3), reflects the experiences of those practicing learning landscape partnerships.

However, the experiential knowledge shared by the participants provides fresh insights, and greater transdisciplinary understanding (see also Jenkins et al., 2012, who also draw attention to the need for ‘embedded experiences’ and Bednarek et al, 2018 in the wider sustainability domain). In general, there is a need to recognise the potential for ‘selfish’ research, which exploits PA managers in the researchers’ interests (see also Moreno et al., 2014); in turn this means that the optimism of partnership working may be sometimes misplaced. It also reinforces the fact that PA managers and researchers are not homogenous; and that success depends on both personal qualities and the wider context in which one works (cf. Prager, 2010). Equally, it is recognised that researchers and PA managers generate different kinds of knowledge and different ways of framing problems (cf. Berkes, 2009). As such, the paper adds to the literature on closing the science - PA management gap through linking transdisciplinary practices with attention to governance and institutional context. By this we mean not only within organisation support and incentives for partnership, but the need to manage the perceptions and actions of opinion-formers such as the media, local communities, politicians, and businesses. These may be part of ‘learning landscape partnerships’, but more often, are exogenous influences on how the partnership priorities are set, communicated, and renegotiated. We believe this connection between the specific lived experiences of those contributing to research- PA manager

partnerships and the wider organisational and governance structures that constrain or enable these partnerships is what makes our contribution unique.

The idea of boundary and bridging organisations (Sternlieb et al., 2013; Stringer and Dougill, 2013; Crona and Parker, 2012; Bednarek, et al., 2018) was also useful in lifting the analysis from a focus on 'how to' build relationships between individual researchers and PA managers, to include a multi-level and dynamic understanding of these partnerships in a pan-European context. We suggest that PA management organisations are boundary agents, who link individuals and practice knowledge exchange, using their protected areas, or protected area practices as boundary objects. However, participants highlighted that such boundary work can best be fruitful when aided by bridging organisations and agents; for example, the potential role of EUROPARC as a facilitator providing contact and learning between multiple learning landscape partnerships. This enables individual good practice to be adapted and applied in many different circumstances and provides an arena for ongoing learning and evaluation regarding how to do these partnerships more effectively in different contexts.

Whilst bridging organisations might help to make learning landscape partnerships more effective and efficient in terms of informing good practice internationally, boundary work seems, in this case, to be about managing power relationships with key supporters and stakeholders. These activities speak to ideas about legitimacy and accountability in partnerships (cf. Cvitanovic et al., 2018). Not only do the researchers and PA managers have to be accountable to their organisations, but they must also be accountable to a heterogeneous and fluid network of those with a stake in the protected area. They must earn their legitimacy in order for the insights of the partnerships to influence the behaviours and choices of these other actors in the polycentric and multi-level environmental governance landscape. This adds to the burden of boundary work and also helps to explain the emphasis on partnership development and preliminary work (see Figure 3), before the actual data collection and analysis can start.

ENDNOTES

¹As stated at: <https://www.iucn.org/theme/protected-areas/about> (last updated: 2018; accessed 14.8.18). The IUCN defines protected areas according to their management objectives. Please see: http://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/ (last updated: 15.01.2014; accessed: 01.10.14).

²The phrase 'learning landscape partnerships' was adopted after

the title of the Cairngorms National Park Authority's research strategy (CNPA, 2014), discussions over which were also partly responsible for the initiation of this project.

³EUROPARC is an umbrella organisation with around 400 members in 36 countries representing a wide variety of protected areas including regional and national parks, and others designated by European Union policies (e.g. Natura 2000).

⁴An advanced Boolean search was undertaken within various search engines for scientific journal publications, including Web of Science, Science Direct and Wiley Online Library.

⁵Participant numbers include representatives of the research funding body (Macaulay Development Trust), and EUROPARC representatives, but exclude members of the collaborative research team acting as workshop facilitators.

⁶<http://www.hutton.ac.uk/research/projects/Learning-Landscape-Partnerships>

⁷See for example, the Parks Canada Agency's Research and Collection Permit System: https://www.pc.gc.ca/apps/rps/page1_e.asp (last updated: 27.01.2017; accessed: 14.8.18).

SUPPLEMENTARY ONLINE MATERIAL

Appendix 1: A transdisciplinary approach

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RESUMEN

Ha habido muchas peticiones para una interacción más eficaz entre la ciencia y la política y el intercambio de conocimientos para abordar los problemas de conservación persistentes; sin embargo, se necesita más claridad en torno a los papeles y las prácticas involucradas. Para enfrentar este desafío, presentamos los resultados de un proceso iterativo y transdisciplinario entre los investigadores y los administradores de áreas protegidas, para identificar las buenas prácticas en el desarrollo de lo que llamamos "asociaciones de paisajes de aprendizaje". Esto se logró mediante una serie de talleres deliberativos, informados por la literatura, para consolidar la experiencia paneuropea de quienes administran y estudian las áreas protegidas. El modelo resultante de "asociación de paisajes de aprendizaje" destaca el papel clave de un "actor que ha sido desatendido" en esas asociaciones: el administrador de áreas protegidas. Los administradores de áreas protegidas pueden actuar como intermediarios en la interpretación de la ciencia para su utilización en la conservación. Sin embargo, esto requiere el reconocimiento de: la delimitación de la labor de los investigadores y los administradores de áreas protegidas; la necesidad de apoyo y estímulo de sus respectivas organizaciones; y el entorno institucional multidimensional por el cual se produce la construcción de la relación. Por lo tanto, para trabajar con administradores de áreas protegidas se requiere una transformación en estos tres ámbitos. La transformación rara vez es directa, pero puede ser necesaria para responder a los desafíos urgentes que en materia de conservación enfrentan nuestros paisajes más valiosos.

RÉSUMÉ

Nombreuses sont les entités qui appellent de leurs vœux une plus grande efficacité dans les interactions entre science et politique et dans les échanges de connaissances afin d'adresser les problèmes persistants en matière de conservation; cependant, il faut davantage de clarté autour des rôles et des pratiques en cause. Pour relever ce défi, nous présentons les résultats d'un processus itératif et transdisciplinaire entre chercheurs et gestionnaires d'aires protégées, afin d'identifier les bonnes pratiques visant à développer un système que nous appelons le «partenariat d'apprentissage pour le paysage». Ces résultats ont été atteints grâce à une série d'ateliers délibératifs qui cherchaient à consolider l'expérience paneuropéenne de ceux qui gèrent et étudient les aires protégées. Le modèle de «partenariat d'apprentissage pour le paysage» qui en a résulté met en évidence le rôle essentiel d'un «acteur négligé» dans de tels partenariats - le gestionnaire de l'aire protégée. De manière fondamentale, les gestionnaires d'aires protégées ont vocation à jouer un rôle d'intermédiaire dans l'interprétation de la science appliquée à la conservation. Cependant, cela exige la prise en compte de trois éléments: les limites du travail des chercheurs individuels et des gestionnaires d'aires protégées ; le besoin de soutien et d'encouragement de la part des organisations respectives ; et le cadre institutionnel multidimensionnel par lequel se noue l'établissement de relations. Dans le contexte du travail avec les gestionnaires d'aires protégées, il est donc nécessaire d'insuffler des transformations dans ces trois domaines. De telles transformations sont rarement simples mais s'avèrent essentielles pour répondre aux défis de conservation urgents auxquels sont confrontés nos paysages les plus précieux.



HARNESSING MULTIPLE TECHNOLOGIES TO COMBAT DEFORESTATION – A CASE STUDY IN THE ALTO MAYO PROTECTED FOREST IN SAN MARTIN, PERU

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ABSTRACT

The authors developed a pilot forest monitoring system in the Alto Mayo Protected Forest, a critically important ecosystem that provides freshwater ecosystem services, habitat for endemic species and forest carbon storage for climate mitigation in San Martin, Peru. The novel forest monitoring system aims at combating deforestation within the protected area, and integrates three components: satellite imagery, acoustic sensors and drones. Setting up a technology-enabled monitoring system in remote regions presents unique challenges, and we highlight the importance of capacity building and local engagement, as well as the need to plan for flexibility to solve technical challenges.

Key words: deforestation, monitoring, protected area management, drones, acoustic sensors, satellites, enforcement, remote alert

INTRODUCTION

Humid tropical forests are critical for mitigating global climate change, conserving biodiversity and ensuring the provision of ecosystem services, including freshwater, to the local population (Costanza et al., 1997; Saatchi et al., 2011; Brandon, 2014; Seymour & Busch, 2016). The Alto Mayo Protected Forest (AMPF) covers approximately 182,000 hectares of high value land for biodiversity conservation and watershed protection in the Peruvian Amazon. This area is part of the larger Abiseo-Condor-Kutukú Conservation Corridor, one of the most threatened ecosystems in the world and home to many endemic plants and animals of global importance, including the yellow-tailed woolly monkey (*Oreonax flavicauda*) and the San Martin titi monkey (*Callicebus oenanthe*) (Schulenberg & Awbrey, 1997). In addition, runoff from the AMPF gives rise to several major rivers and the provision of freshwater to local communities in the Alto Mayo basin and allows the economic activities on which local populations

depend. For example, the Yuracyacu River provides water for the city of Nueva Cajamarca, with over 35,000 people (INEI, 2007), while supporting the irrigation of over 9,000 hectares of rice cultivation downstream. The AMPF provides many additional local benefits including the prevention of soil erosion, the protection of soils in the lowland areas from torrential flows and floods, and the enhancement of scenic beauty (Alto Mayo Conservation Initiative, 2012). The high carbon stocks in the AMPF provide global benefits by sequestering carbon and release significant greenhouse gas (GHG) emissions when deforested. Acknowledging the cultural and ecological value of the area, the Peruvian government established the AMPF in 1987 as part of the National Service of Natural Protected Areas (SINANPE).

Despite its designation and recognition in providing ecosystem services and habitat for endemic species, deforestation continued unabated in the AMPF due to increasing pressure from a growing migrant population

and the expansion of conventional coffee farming. In response to these increasing threats, Conservation International (CI) began to work with local partners to promote the sustainable management of the AMPF for the benefit of both local and global populations, as well as for the range of biodiversity dependent on the forest. CI recognised that the key to achieving significant greenhouse gas (GHG) emissions reductions and safeguarding ecosystem service provision in the AMPF was the development of a mechanism that included an economic valuation of the forest that could show competitiveness with alternative land uses. This resulted in the development of a REDD+ project in the AMPF beginning in 2008. The REDD+ project, verified by the Verified Carbon Standard and the Climate, Community and Biodiversity Standards, has included the creation of conservation agreements with communities living within the AMPF and its buffer zone to stop deforestation in exchange for technical agricultural support.

While recent conservation gains in the AMPF have resulted in an overall reduction in deforestation (Alto Mayo Conservation Initiative, 2016), ecosystems continue to be deforested. One of the key challenges in stopping deforestation in the AMPF is the ability to effectively and efficiently monitor activities over vast forest areas with limited personnel (Alto Mayo Conservation Initiative, 2012). The size, remoteness and accessibility of the protected area limit patrolling activities. Remote sensing-based monitoring of the area is also hampered by persistent cloud cover. These limitations result in substantial lags between the time when a deforestation event occurs and the detection of the event. Critical time is lost, and the perpetrators are gone by the time the event is detected and the rangers can mobilise. This has resulted in the need for a system

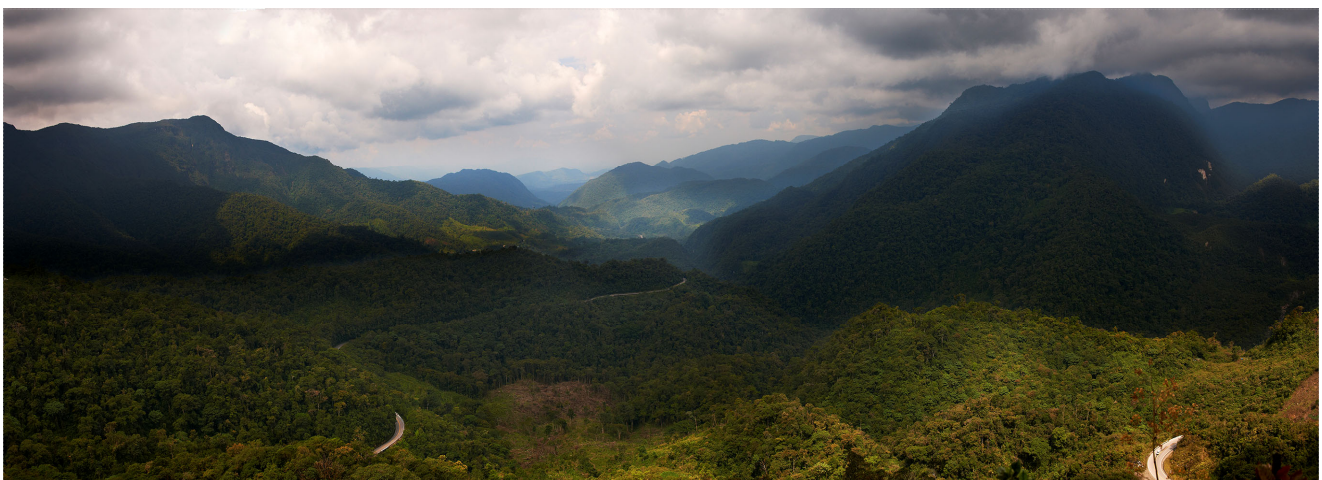
that enables rangers to react more quickly to deforestation events within the protected area to prevent forest loss and deter other illegal activities.

We describe a novel, integrated forest monitoring system that leverages cutting edge technology to empower rangers to stop deforestation in the AMPF. The system integrates three components: acoustic sensors, unmanned aerial vehicles and a satellite-based fire detection and near real-time alert system (Firecast). The joint application of these technologies allows forest disturbances to be detected more rapidly and across a larger geographic area than by conventional monitoring techniques.

COMPONENTS OF THE SYSTEM

Acoustic sensors

A customised network of acoustic sensors was developed and deployed by Rainforest Connection (RFCx) (<https://rfcx.org/>). The acoustic sensors, constructed using recycled cell phones and solar panels, were used to detect chainsaw sounds, the primary tool for forest clearance within the protected area. Each sensor continuously collects acoustic data and sends the information to a cloud server where it is processed using an algorithm that identifies acoustic event signatures. When an event is detected, an alert is created, and this information can be sent to rangers on the ground via email through Firecast (see below). The entire process, from the time that the event occurs to the alert delivery, takes only a few minutes making it a real-time monitoring system. The location of each sensor is recorded in the cloud server, and a single acoustic sensor can detect chainsaw sounds up to one kilometre away depending on the topography and the forest density.



Panoramic view of the Alto Mayo Landscape © Thomas Muller

Drones

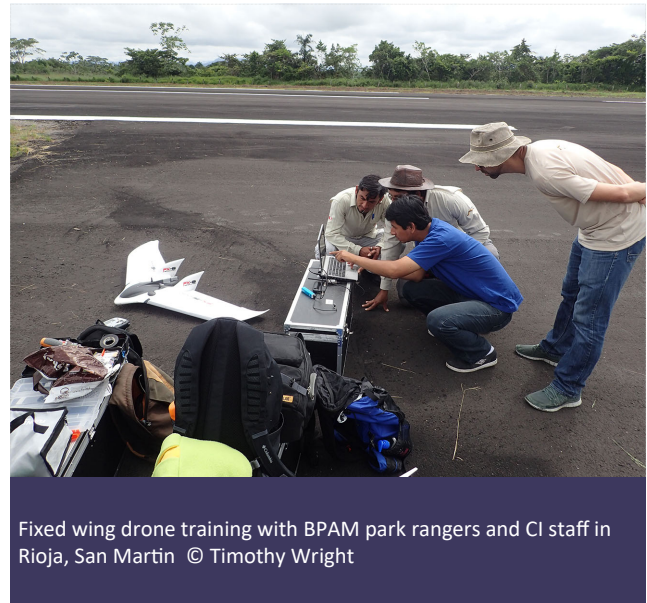
Due to cost reductions and access to open-source software, drones are increasingly used in a wide range of conservation applications (Kho et al., 2012; Zhang et al., 2016; Crutsinger et al., 2016). Drones used in this pilot study were implemented through a partnership with the University of Adelaide. Two main types of drone exist, with their own strengths and limitations: multirotor and fixed-wing. The authors deployed FX-61 fixed-wing drones outfitted with Canon S100 cameras. Fixed-wing drones were chosen because they have a longer flight time and can cover a superior distance to verify deforestation alerts from the acoustic sensors. The FX-61 drones can be piloted manually or using mission planning software such as Mission Planner (<http://ardupilot.org/planner/>). Manual piloting is useful to ensure that the drone does not run into any obstacle or to take control of the drone if an error occurs during the flight. However, for many applications, especially mapping and monitoring, it is preferable to use a mission planner to regularly survey an area of interest or fly the drone to a distant location for reconnaissance. After the drone has completed its mission, images are uploaded into an image processing software and orthomosaic images are created. Alternatively, the drone can collect video footage.

Firecast

Firecast is an operational forest and fire monitoring and alert system developed by CI with support from NASA, ESRI and Logi Analytics (<http://firecast.conservation.org/>). The Firecast system disseminates near real-time email alerts of remotely-sensed active fires from NASA's Fire Information and Management System (FIRMS); it provides daily fire danger forecasts for the Amazon region based on satellite-derived measures of precipitation, temperature and relative humidity (Steininger et al., 2013); and generates annual 250-m Quarterly Index of Forest Cover Change (QUICC) forest disturbance alerts (Potter et al., 2003). Users can subscribe to specific areas of interest and receive tailored alerts whenever a fire is detected within that region. Since Firecast is already disseminating active fire data and annual forest disturbance alerts for Peru, and the rangers in Alto Mayo are familiar with the system, it was the tool of choice for disseminating alerts from acoustic sensors.

IMPLEMENTATION AND RESULTS

A total of 10 acoustic sensors were deployed across the landscape along the south-eastern edge of the AMPF, covering an area of approximately 4,200 ha. The most challenging aspect of setting up the network was the lack of wireless connectivity within the protected area,



Fixed wing drone training with BPAM park rangers and CI staff in Rioja, San Martin © Timothy Wright

inhibiting the transmission of acoustic data from the field to the server. To address this issue, a cell phone repeater was set up in the buffer zone of the protected area to expand the mobile network; this network was then used to deliver the data from the acoustic sensors to the server. Alternative methods were tested to increase connectivity by linking sensors through a node/mesh system but were deemed insufficient because they would either require additional and currently unavailable technology, or they would be too expensive for long-term monitoring. Ultimately, the boosted cell phone network proved to be the most effective approach for implementing the pilot study.

Four fixed-wing drones were purchased, including two practice drones (without cameras) and two mapping drones (with cameras). To test the range of the FX-61 mapping drones, a successful 3 km mapping mission was performed in Rioja, outside the protected area, flying at an altitude of 150 m. The drone captured 245 images, which were used to create an orthomosaic image, using Pix4D image processing software (<https://pix4d.com/>), covering an area of 108,174 ha. A full report of the mission (in Spanish) is attached as supplementary material. We estimate that the battery of the drone could safely operate at twice this distance, making the functional range closer to 6 km. In the future, we will identify adequate landing zones within the AMPF, which can be used for reconnaissance or mapping missions within the protected area.

The Firecast system server was modified to check for chainsaw alerts from the cloud server, which analyses acoustic data every 10 minutes. Alerts were automatically sent by email to park rangers with the



The Rio Mayo in San Martin Peru © Thomas Muller

location of the acoustic sensor that was triggered, the time of the alert and a link to the audio file for manual verification. To limit the number of alerts from the same chainsaw event, new alerts from a sensor were only sent if of higher confidence than previous alerts within a 12-hour period. The chainsaw alerts and Firecast email dissemination were successfully tested in the field.

LESSONS LEARNED AND DISCUSSION

Implementing new technologies in remote locations to tackle urgent problems presents challenges that require innovative solutions. One of the initial challenges was the remote geography; many regions in the AMPF are not readily accessible and there is almost no wireless connectivity within the protected area. Some technological experimentation was required to overcome this issue and scaling the pilot to cover the entire protected area will require increasing the connectivity and reliability of data transfer. The expansion of the acoustic network will target key areas within the protected area, based on risk or ecological significance.

The drone component of the integrated forest monitoring system was a success. The fixed-wing drones proved to have good flight time and range,

making them ideal for verifying deforestation alerts while penetrating further into the protected area. They are also well suited for medium area, high resolution mapping and may provide information on post-deforestation land use, forest regeneration and mapping different land use in the buffer area, such as sustainable coffee plantation. On the other hand, we found that performing long-range missions is not as simple as setting a waypoint near an alert or area of interest and sending a drone to investigate. The planning process required for a long-range mission is complex and can take significant time, due to the nature of the topography and the need to balance flight time, distance and image resolution. Another challenge was to identify adequate landing sites for the drones within the AMPF or its buffer zone. The amount of space required to land drones was a limiting factor within the dense forested protected area. Fixed-wing drones require approximately 100 metres of open space to glide in for landing. A combination of local knowledge and GIS analysis was used to identify landing zones throughout the protected area and buffer zone. Finally, we found that fixed-wing drones are more cost effective than multirotor drones, and that they have an adequate flight range; however, they are more complicated to operate, and additional capacity building was needed to transfer skills to park rangers. The fixed-wing drones proved to

be an asset in the monitoring system, but they require some practice and experience to be applied effectively. Integration with the Firecast system proved to be a successful way to communicate alerts via email. Both the fire and acoustic alerts could be combined in a single platform. Building upon a technology that is already being used in the field, such as Firecast, allows for greater coordination in monitoring efforts, and streamlines the process of receiving near real-time forest disturbance event alerts.

One aspect that was not fully considered before the start of this pilot was the effect that social factors could have on the success or failure of a pilot project. Social factors can impact the timeline of a project, and to ensure the longevity of the monitoring system in development, we worked with local land-owners within the buffer zone to house some of the equipment to expand the mobile network from their property. This kind of community engagement proved to be a successful way to ensure local buy-in and to prevent the equipment from being vandalised or stolen.

CONCLUSIONS AND NEXT STEPS

Our pilot integrated forest monitoring system successfully demonstrated how the application of novel remote sensing technologies can be leveraged to detect deforestation events in near real-time. The use of an integrated forest monitoring system has the potential to reduce the latency between a deforestation event detection from months to minutes, allowing rangers to respond more quickly and effectively. Nevertheless, some system improvements are still needed.

A critical next step is expanding the acoustic sensor network to cover a larger proportion of the protected area. The key logistical challenge is how to deploy a whole sensor network in the most remote areas of the protected area where deforestation occurs. This will likely involve training local people, who can partner with rangers in the deployment and maintenance of the

acoustic sensors. Another consideration that needs to be addressed when expanding the acoustic sensor network is the reliability and consistence of data transmissions. Using the existing mobile network to transfer acoustic data proved problematic as the bandwidth limited the amount of data that could be transferred. Therefore, the next phase of the project will seek to streamline the acoustic data transmission by performing some of the detection analysis locally and using a satellite uplink to ensure a continuous flow of data from the field to the server.

Increasing the capacity of the drone fleet in the AMPF will also strengthen the monitoring system. The four fixed-wing drones that were acquired for this pilot allowed for long-range reconnaissance and detailed area mapping. However, there is an opportunity to expand the drone fleet in the AMPF and build capacity to better master drone technology. For example, compact multirotor drones could be taken on patrol and operated in areas that would be ill-suited for larger fixed-wing drones. The addition of multispectral sensors to the drones would also facilitate a range of additional vegetation mapping applications, such as monitoring vegetation health and stress or the impact of nutrient inputs.

The acoustic data can be leveraged to provide more information about deforestation trends and the effectiveness of conservation action in the region. Currently, the acoustic sensors are only being utilised for the detection and dissemination of chainsaw alerts. However, all the acoustic data is stored in the server, and this information can be used for additional applications. For example, the frequency and duration of chainsaw detections could help to determine whether a deforestation event is more likely for logging, land clearance for agriculture or firewood collection. The acoustic data can also be used to monitor biodiversity through the identification of individual species or through analysis of the soundscape to determine



Solar panel and acoustic sensor mounted in the canopy © James Reed



Drone image of an acoustic sensor installed in the forest canopy near the protected forest © Timothy Wright

biological richness (Pijanowski et al., 2011; Blumstein et al., 2011;). Additional analysis could also be conducted to link chainsaw disturbances to biological responses to better understand human–wildlife interaction.

Finally, it is critical to maintain and build capacity so that these technologies can be leveraged to greatest effect. Technology applications for enhanced forest monitoring are only as effective as the people who implement and maintain the system. The AMPF in Peru is an ideal location to test the integrated forest monitoring system because there is already technical capacity and commitment in place, as well as many pressing challenges. This pilot monitoring system may readily be applied to improve the forest monitoring system in Alto Mayo as well as to replicate it in other locations.

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RESUMEN

Los autores desarrollaron un sistema piloto para el monitoreo de bosques en el Bosque Protegido Alto Mayo, un ecosistema de importancia crítica que proporciona servicios de los ecosistemas de agua dulce, hábitat para especies endémicas y almacenamiento de carbono forestal para la mitigación del cambio climático en San Martín, Perú. El novedoso sistema de monitoreo forestal apunta a combatir la deforestación dentro del área protegida e integra tres componentes: imágenes satelitales, sensores acústicos y drones. La configuración de un sistema tecnológico de monitoreo en regiones remotas presenta desafíos únicos, y destacamos la importancia de la creación de capacidad y la participación local, así como la necesidad de planes con cierto grado de flexibilidad para resolver los desafíos técnicos.

RÉSUMÉ

Les auteurs ont mis au point un système de surveillance forestière expérimental dans la Forêt Protégée d'Alto Mayo, un écosystème d'une importance capitale qui fournit des services écosystémiques en eau douce, un habitat pour les espèces endémiques et une réserve de carbone forestier pour atténuer les changements climatiques à San Martín, au Pérou. Le nouveau système de surveillance des forêts vise à lutter contre la déforestation au sein de l'aire protégée et se compose de trois axes: l'imagerie par satellite, les capteurs acoustiques et les drones. La mise en place d'un système de surveillance basé sur la technologie dans les régions éloignées présente des défis uniques, et nous soulignons l'importance du renforcement des capacités et de l'engagement local, ainsi que la nécessité de démontrer de la souplesse au niveau de la planification pour résoudre les problèmes techniques.



INFLUENCE OF ENVIRONMENTAL GOVERNANCE REGIMES ON THE CAPACITY OF INDIGENOUS PEOPLES TO PARTICIPATE IN CONSERVATION MANAGEMENT

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ABSTRACT

A range of international, national and local policy instruments and governance regimes acknowledge Indigenous and local people's knowledge as a key platform for managing biodiversity and ecosystems, but translation of these commitments into negotiation of conservation priorities with appropriately empowered local communities remains inconsistent. Drawing on a review of conservation area management plans in Australian bioregions identified as having high potential for Indigenous engagement in threatened species management, we examined how the potential for local Indigenous communities to pursue their conservation objectives and the extent to which they are involved in management of significant species, cultural heritage and fire is influenced by different environmental governance regimes. We found that there is currently more scope for Indigenous communities to participate in cultural heritage management than in species or fire management, despite evidence that Indigenous communities seek to engage in managing all aspects of their traditional estates. Species management priorities in Indigenous-driven co-governance regime plans centre on culturally significant species rather than threatened species. We conclude that the current potential for local Indigenous communities to participate in conservation management on equitable terms depends upon the establishment of Indigenous-driven co-governance regimes, and argue that improving levels of engagement of Indigenous Peoples in agency governance regimes requires agencies to better recognise Indigenous worldviews in planning conservation approaches. .

Key words: Indigenous Peoples, environmental governance, conservation management, cultural heritage, threatened species

INTRODUCTION

Indigenous Peoples need to play a key role in contemporary conservation planning and management. Much of the world's biodiversity occurs on land inhabited or owned by Indigenous Peoples, including both areas formally dedicated to conservation purposes and land which is outside the conservation estate but nonetheless has significant biodiversity values (Garnett et al., 2018; Oviedo et al., 2000; Renwick et al., 2017; Sobrevila, 2008). In many of these areas, Indigenous Peoples have maintained long and sustainable connections to their environments and have deep

knowledge of local social, ecological and cultural contexts (Berkes & Turner, 2006). Partnerships between Indigenous Peoples and agency managers can therefore provide unique opportunities to protect and manage areas with high conservation values effectively (Austin et al., 2018; Moritz et al., 2013).

Engaging Indigenous Peoples in conservation planning and decision-making is also an ethical and legal obligation. The high conservation significance of Indigenous lands has meant that local Indigenous communities have often been disadvantaged by

conservation actions, for example by forced removals from traditional lands to create protected areas or by restrictions to their customary access and resource use (Colchester, 2004; Guha, 2003). Such restrictions have a disproportionate impact on Indigenous Peoples, who often depend on connections to traditional lands and access to natural resources to maintain their cultural and economic livelihoods (Kaimowitz & Sheil, 2007; Langton, 2003) and who often lack the political power to influence the decisions made by governments and conservation organisations (Brosius et al., 1998). Growing awareness of these issues and recognition of the rights of Indigenous Peoples to control and manage traditional lands has increasingly compelled conservation managers to seek collaborations with local Indigenous communities (Colchester, 2004; Schmidt & Peterson, 2009).

Global and national conservation policy and legislative frameworks have set out key expectations detailing why and how Indigenous Peoples have a role to play in the sustainability of our planet. The development of the Conservation Initiative on Human Rights (CIHR), an alliance of global conservation organisations which seeks to improve inclusion of human rights in conservation policy, was triggered partly by the advocacy of Indigenous leaders (Springer & Campese, 2011). Aichi Targets 11 and 18 in the Convention on Biological Diversity Strategic Plan for Biodiversity 2011-2020 (Convention on Biological Diversity, 2010) commit to increasing equity in the management of protected areas and integrating the knowledge and management practices of Indigenous Peoples in biodiversity maintenance objectives respectively. The International Union for the Conservation of Nature (IUCN) recognises that Indigenous Peoples have rights to maintain links to their traditional lands and to participate in planning conservation strategies (Jonas et al., 2014). These policy commitments have resulted in a focus on planning processes and governance structures which attempt to increase Indigenous participation. Changes in the IUCN criteria allowed Indigenous and Community Conserved Areas (ICCAs), defined as areas voluntarily conserved by local or Indigenous communities through customary law, to be considered formally protected areas (Brosius, 2004). The participation of Indigenous communities in the management of protected areas through joint-management and co-management arrangements has become more common in many countries. Protected areas managed by local and Indigenous communities can be as good as (and in some cases better than) state managed areas at conserving biodiversity (Porter-Bolland et al., 2012; Schleicher et al., 2017).

Despite these changes in policy and governance, conservation approaches in many countries are dominated by Western conservation paradigms focused on values such as 'biodiversity', 'threatened species' and 'wilderness' (Adams, 2004; Corrigan et al., 2018), and local Indigenous communities continue to face challenges in participating in conservation management in ways that satisfy their own aspirations and responsibilities (Barbour & Schlesinger, 2012). The conservation objectives of Indigenous Peoples are diverse, but some common themes are discernible. While Western conservation paradigms tend to separate human and natural elements of the landscape, Indigenous conservation approaches often emphasise the importance of dealing with landscapes, people and plants and animals as connected elements of an interdependent system (Roberts et al., 1995; Salmon, 2000). Maintaining cultural and natural values therefore depends on integrated, holistic and adaptive management approaches (Yibarbuk et al., 2001). Recognition of this has led to the adoption of terms that acknowledge the importance of the cultural context in conservation management and are more relevant to Indigenous conservation approaches. For example, the term 'cultural landscapes' has been used to link natural and cultural values, along with the knowledges and practices that sustain them, in protected World Heritage Areas (Carter, 2010). In Australia, local Indigenous communities and their collaborators often use the term 'caring for country' (which can include both land- and sea-scapes) to refer to a relationship of reciprocal care between Indigenous custodians and the land (e.g. Ens et al., 2012; Preuss & Dixon, 2012; Yunupingu & Muller, 2009).

The capacity to form socially equitable conservation partnerships that help local Indigenous communities to protect and maintain these values can be enhanced by analysis of the dimensions of equity and their relationship to conservation planning and governance (Moreaux et al., 2018; Schreckenberget al., 2016). In a discussion of equity in Payments for Environmental Services (PES), McDermott et al. (2013) identify three dimensions of equity as integral to the delivery of benefits to all participants. 'Distributional equity', is concerned with the distribution of costs, benefits and risks among partners. 'Procedural equity' involves recognising and including partners in planning and decision-making processes. 'Contextual equity' entails recognition that the institutional and political context in which participation occurs favours some participants more than others, and that this can enable or limit their capacities to engage in and benefit from environmental management. For example, some conservation

collaborations have been criticised for incorporating Indigenous knowledge or labour to increase the effectiveness of agency conservation objectives but not taking into account the aspirations of Indigenous partners (Barbour & Schlesinger, 2012). While such partnerships might deliver distributive equity (e.g. through the economic benefits of Indigenous employment), they fail to recognise the importance of procedural equity. Conversely, in instances where local Indigenous communities have gained access to procedural equity by transforming institutional structures and compelling agencies to include Indigenous participation in decision-making, they have gained benefits which include greater control over traditional lands and resources (Lane & Hibbard, 2005). Whether or not different aspects of equity are included in collaborative conservation management planning processes can therefore act as an indicator of the success of current efforts to engage Indigenous Peoples in conservation, as well as identify the governance structures that promote equitable collaborations.

The aim of this paper is to compare the influence different environmental governance regimes have on the scope and focus of local Indigenous community engagement. We do this by using a sample of Australian conservation planning documents to explore three subsidiary research objectives: (1) to compare levels of Indigenous engagement in conservation management under different governance regimes; (2) to examine agency expectations of Indigenous roles in collaborative management; and (3) to compare stated management priorities for species that are considered important (e.g. threatened species, culturally important species) under different governance regimes.

RESEARCH CONTEXT AND METHODS

Australia is an appropriate country in which to base our case study because local Indigenous communities play a crucial role in conservation management, under a variety of governance regimes and geographic settings (Hill et al., 2012; Renwick et al., 2017). Conservation legislation and policy, including the Biodiversity Conservation Strategy 2010-2030 (Natural Resource Management Ministerial Council, 2010), the *Environment Protection and Biodiversity Conservation Act 1999*, and the National Threatened Species Strategy (Department of the Environment and Energy, 2010), commits to Indigenous engagement in conservation management. Realisation in the mid-1990s that inclusion of Indigenous lands was crucial to developing a representative National Reserve System led to the establishment of Indigenous Protected Areas, which

now make up nearly half of all land managed for conservation purposes (Renwick et al., 2017). Local Indigenous communities can also be included in governance structures through joint management of state and national conservation areas. However, most conservation areas in Australia continue to be managed exclusively under state, territory or national governance regimes.

Our investigation builds on previous research by Renwick et al. (2017) which identifies Australian bioregions with high potential for Indigenous engagement in threatened species management, based on overlap between Indigenous land tenure and occurrence of threatened species. The bioregions in each Australian state or territory with the highest potential for engagement were used as our sample, because we considered that in such areas contrasts in the conservation values and priorities of government agencies and prospective Indigenous collaborators would be most apparent. These areas also contain species which are important to local Indigenous communities for a range of cultural and utilitarian reasons. The remainder of this article will use the neutral term 'significant species' to denote those plants and animals which are perceived to be important irrespective of the world view of those valuing them. The amount of Indigenous land tenure types in each bioregion is included in the Supplementary Information.

We then identified conservation areas within these bioregions using a national database of conservation areas (Department of the Environment and Energy, 2014), and conducted online searches to locate available management plans for each formal conservation area. Our criteria for inclusion of plans in the analysis were documents that described conservation values of a defined area and identified strategies to protect or improve those values (generally called 'Plans of Management' or 'Healthy Country Plans'). While sample bioregions also included areas under management regimes which may provide beneficial conservation outcomes but are not listed as formal conservation areas (e.g. some Indigenous land tenures), these were not identifiable from the database used and were therefore not included in the analysis. We used these documents as our data source because they (1) describe the governance structures under which management takes place; (2) list the roles and responsibilities held by the governance body and any relevant partners or stakeholders, including evidence of collaboration or intent to collaborate in management, and (3) list the perceived conservation values and priorities in the area covered by the plan and evidence of conflicts and

synergies in the perspectives of governance partners. We acknowledge that our data sources state intentions and commitments and so do not necessarily correspond to actual implementation of management actions and levels of participation in the conservation areas discussed, and do not allow a deeper analysis of the barriers Indigenous people face in engaging in conservation partnerships. Further research to illuminate these constraints would involve interviews, preferably by Indigenous researchers, and other on-ground investigation.

Analysis of management plans

We categorised publicly available conservation management plans according to publication date and governance regime. We used the typology of Hill et al. (2012) as the basis for our governance categorisation because it classifies Indigenous engagement into four categories defined by the relative degree of power-sharing between Indigenous and government agency partners, and although based on Australian contexts, is also applicable to international collaborations.

1. Indigenous governed collaborations (Indigenous collaborations) that are initiated by Indigenous actors, with decision-making and planning shared between an alliance of Indigenous organisations. Such plans would also need to have been entered into the database of conservation areas defined by agency legislation from which we obtained our list of areas for which plans might be available.
2. Indigenous-driven co-governance regimes (Indigenous co-governance) that are often created within government legislative structures, but retain high levels of Indigenous control over decision-making and planning within those structures. The most common manifestation of this governance regime in Australia are Indigenous Protected Areas (IPAs).
3. Agency-driven co-governance models (agency co-governance) that are created within existing planning regimes. These governance arrangements recognise Indigenous rights but decisions are framed on agency definitions of

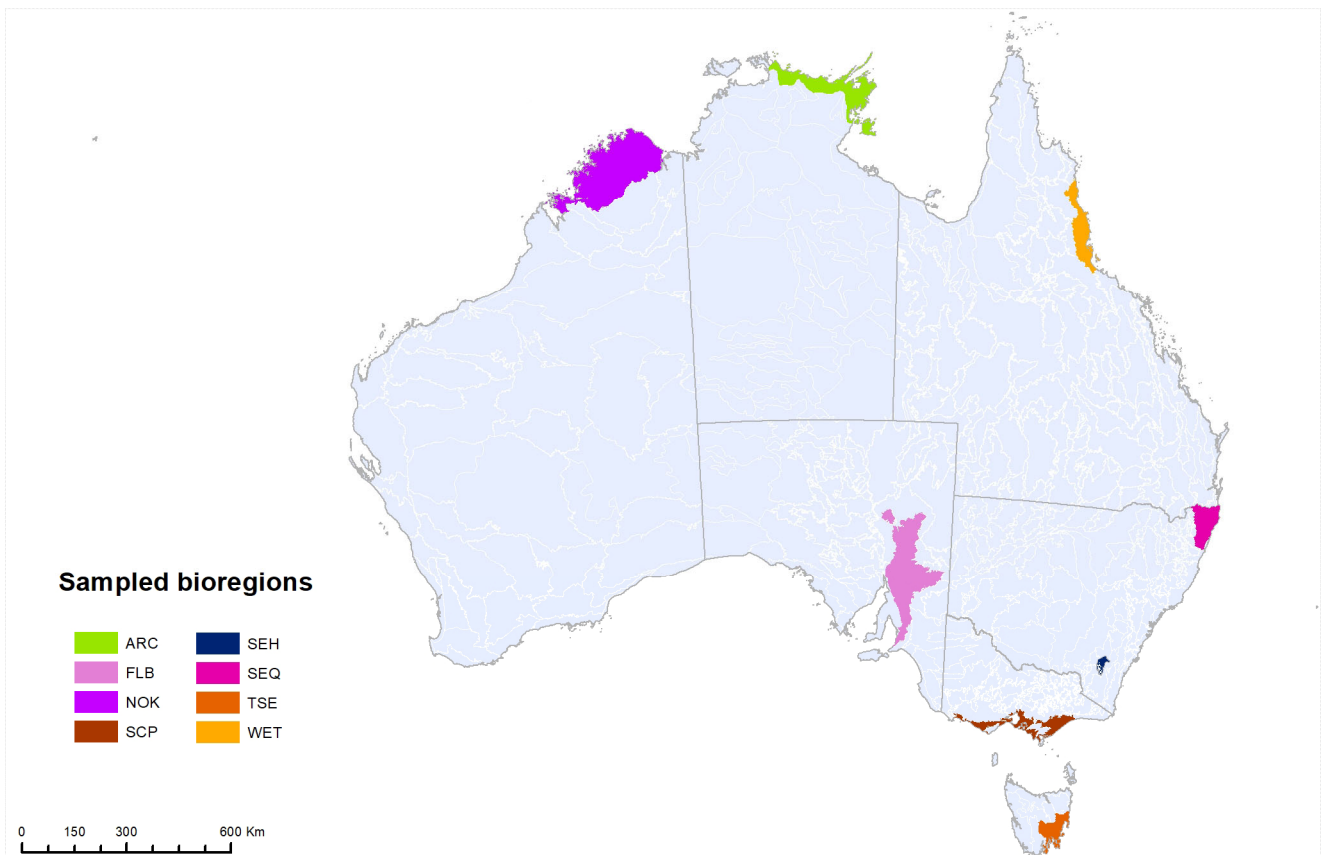


Figure 1. Sample bioregions from which conservation management plans were reviewed (ARC = Arnhem Coast, FLB = Flinders Lofty Block, NOK = Northern Kimberley, SCP = South East Coastal Plain, SEH = South Eastern Highlands, SEQ = South Eastern Queensland, TSE = Tasmanian South East, WET = Wet Tropics)

those rights. In Australia, these include conservation areas managed under formal joint-management agreements.

4. Agency governance regimes (agency governance) engage with Indigenous groups as stakeholders rather than a group with a distinct political status or right to planning and decision-making. These are legally-declared conservation areas with no formal structures to include local Indigenous communities in governance.

A summary review of plans across governance regimes identified three general categories in which management was focused, present in most plans as a specific section: significant species, fire and cultural heritage. These categories were chosen to compare levels of engagement because both agencies and local Indigenous communities commonly describe them as a management focus, but with different conservation objectives (e.g. Kaimowitz & Sheil, 2007; Roberts et al., 1995; Suchet, 2002). Text searches were undertaken in each plan using a list of search terms to identify (a) whether plans committed to management of significant species, fire and cultural heritage, and (b) if so, whether plans included evidence of Indigenous engagement in each management theme. We categorised levels of engagement into three classes to differentiate between intended and actual engagement: ‘absent’, if there was evidence for management for that theme being undertaken, but no mention of engagement with local Indigenous communities; ‘aspirational’, where a commitment or intention to engage with Indigenous groups was stated but there was no evidence that active participation was occurring; and ‘active’, where there

was evidence that Indigenous groups were actively involved in management of that category. To maximise consistency between the two authors involved in the review process, an initial trial review of one plan was undertaken independently by each reviewer, and the results compared for agreement. Both reviewers defined plans consistently in all criteria. Throughout the review process, excerpts of the evidence used by each reviewer to classify the level of engagement were recorded, and any instances of ambiguity or uncertainty resolved through discussion between the reviewers. These excerpts also provided an additional source of qualitative evidence of the values and priorities articulated under different governance approaches.

RESULTS

In total, 128 management plans were available for review from the eight sample bioregions: 107 were from agency governance regime plans, 10 were from agency co-governance regimes, and 11 were from Indigenous co-governance regimes. There were no Indigenous collaboration regimes identified in our data set, but this may be an artefact of our sampling procedure as such collaborations may not be listed in the databases we interrogated. There were no publicly available management plans for most conservation areas in our case study area, and reviewed plans were unlikely to be representative of governance approaches in a bioregion.

Engagement, management focus and agency expectations

All plans analysed included commitments to manage significant species, but a small number of plans failed to consider fire (10) or cultural heritage (six) (Figure 2).



Cycad species are significant cultural and food plants in some parts of Australia © Tom Duncan

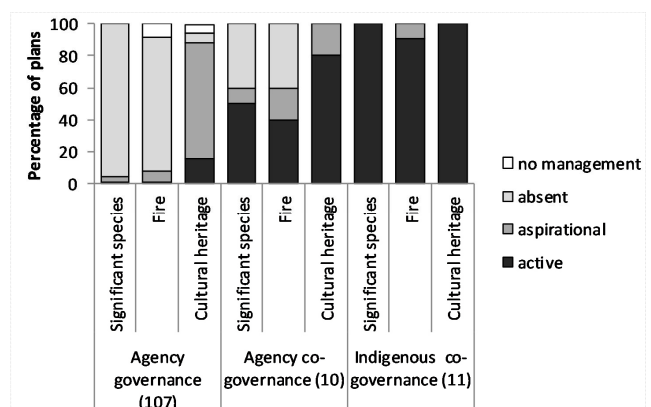


Figure 2. Commitment to Indigenous engagement in significant species, fire and cultural heritage management in conservation plans prepared for conservation areas under three types of governance regime in Australian regions with high potential for Indigenous involvement (bracketed figures are the number of plans analysed).

Table 1. Management objectives and roles for Indigenous collaborators in agency governance regime plans

Plan	Indigenous role	Quote
Devil Bend Natural Features Reserve Management Plan (2010)	contribute knowledge to agency-defined fauna management objectives	“reflect Indigenous knowledge of fauna in management practices where practical.”
Macleod Morass and Jones Bay Wildlife Reserves Management Plan (2005)	contribute knowledge to agency-defined fauna management objectives	“encourage research into Indigenous peoples’ folklore and customs relating to fauna of the planning area... reflect and integrate knowledge gained in all management programs.”
The Parks and Reserves of the Northern Richmond Range Management Plan (2005)	contribute to fire management planning within the context of cultural heritage management	“involve representatives of local Aboriginal people in the preparation of fire management strategies to ensure that fire management activities do not impact on Aboriginal sites and/or places of significance.”
Yuraygir National Park and Yuraygir State Conservation Area Plan of Management (2003)	contribute to fire management planning within the context of cultural heritage management	“ensure local Aboriginal communities are involved in the development of fire management strategies ... to protect Aboriginal cultural heritage values.”

Indigenous engagement in agency governance regimes was generally associated with cultural heritage management, with little scope for participation in fire management and even less so in significant species management. For each of the three management categories in agency governance regime plans, engagement was more likely to be an aspiration than to be actively occurring.

Qualitative analysis of the few agency governance regime plans which commit to Indigenous engagement in significant species and fire management show that roles of Indigenous partners were generally limited to inclusion of knowledge to improve management of agency-defined values (Table 1). In other cases, Indigenous roles were confined to management of areas perceived to be of legitimate interest to local Indigenous communities, such as the potential impacts of fire on cultural heritage sites.

In most cases, qualitative analysis of cultural heritage management sections agreed with quantitative findings indicating higher rates of Indigenous participation. Compared to significant species and fire management sections, cultural heritage sections of plans tended to use more inclusive language, with terms such as ‘cooperation’ and ‘partnerships’ more commonly used. Defined roles were more specific, and some plans cited an intention to formalise partnerships in cultural heritage management. However, aspirations to engage Indigenous partners were more common than active

participation, and the language used to describe engagement was often vague and non-committal. For example, local Indigenous communities were said to have had “an input into decisions affecting their interests” (Brook Islands National Park Management Plan 1999) and were “encouraged to assist” in protection of cultural heritage (Ballina Nature Reserve Management Plan 2003). Other plans imply that Indigenous perceptions of values and priorities are ultimately subordinate to those of the agency, by committing to “provide opportunities for Aboriginal communities to participate in the protection and management of Aboriginal sites within the Reserve, consistent with the objectives and strategies in this plan” (Cudgen Nature Reserve Management Plan 1998).

Agency co-governance regime plans showed higher levels of engagement in significant species and fire management than agency governance regimes, but active engagement was reported in less than half such plans. In comparison to agency governance regimes, agency co-governance regimes appeared to have been more actively engaged with Indigenous groups in cultural heritage management. Some agency co-governance regime plans were explicit about the importance of involving Indigenous partners in all three management categories and linked this to maintaining cultural health. For example, the Gunaikurnai Whole of Country Plan (2015) states: “We want to be actively managing the water, fire, wildlife and biodiversity on our Country, and helping others to... do this in a culturally appropriate way.”

All reviewed Indigenous co-governance approach plans described active management being undertaken in all three management categories, apart from one plan in which fire management remained an aspiration. Management targets in these plans included 'saltwater fish', 'native animals', 'food and medicine plants', 'right-way fire', and 'healthy fire'. In these plans, the roles of Indigenous partners were much more than just custodians of culturally significant sites, because management of significant species and fire were described as major concerns.

Significant species

In Indigenous co-governance plans, where species were identified as targets for management, it was generally as plants and animals or groups of plants and animals with cultural significance (Table 2).

Threatened species were generally not considered management priorities in Indigenous co-governance plans. Where threatened species were considered significant, it was because they also happened to be culturally significant species (e.g. Dugong *Dugong*

Table 2. Significant species named as management targets and cultural significance in Indigenous co-governance conservation plans

Plan	Significant species	Cultural significance and management protocols
Dambimangari Healthy Country Plan	Turtle and Dugong	"Jurluwarra (Saltwater-turtle) and warliny (Dugong) are important to Dambimangari people as an important food source." "We have many traditional stories for jurluwarra and warliny and their cultural use is interwoven with our traditional lifestyles."
	Whales and dolphins	"There are stories about the whales and creation of our coastline in our culture."
	Native animals for food	"All the animals have their own songs and stories; some have their images in caves or in stone arrangements."
	Bush fruit and bush medicine	"All the plants on our country are important for Dambimangari people. We use them for tucker, medicine, tools, weapons, arts and crafts."
	Wulumarany (freshwater turtles)	"Young people are not allowed to eat wulumarany until their back has been scratched by these tortoises."
Balanggarra Healthy Country Plan 2012-2022	Native animals	"When we talk about Native Animals in this Plan, we are talking about animals Balanggarra people were hunting traditionally in the past and animals that have cultural significance for Balanggarra." "We are only hunting for our traditionally important animals when it is the right season."
Wunambal Gaambera Healthy Country Plan	Aamba (kangaroos and wallabies) and other meat foods	"When we talk about aamba and how we should look after them we are also talking about other meat foods found in the moree (savanna woodland)."
Djelk Healthy Country Plan	Culturally important plants and animals	"Many of these species have special cultural significance as totems or dreaming species and many other species we use for bush tucker, medicine, tools and for art and craft."
Dhimurru Indigenous Protected Area Management Plan	Bäru (Estuarine Crocodile <i>Crocodylus porosus</i>)	"Hunting or killing Bäru is governed by strict customs that are managed by the clans that are custodians of the principal myth narrative."

dugon, marine turtles and Northern Quoll *Dasyurus hallucatus*), and this was stated as the motivating factor in listing them as management priorities. Use of plants and animals for food, medicine and materials was linked to maintaining cultural heritage, and was in turn prescribed by customary laws and knowledge associated with cultural health, for example by undertaking rituals to ensure populations of plant and animal species remain healthy.

Similarly, threats to plants and animals were often perceived within the wider cultural context rather than ecological changes. Changes in social networks were given as the reason that odor (Dugong) have become more difficult to hunt in the Bardi Jawi Healthy Country Plan (2013):

Hunters are often approached by relatives in Broome and further afield for a share of meat from country for their families. This has widened the distribution circle and put more pressure on skilful hunters (and the species).

Where threatened species were mentioned in Indigenous co-governance plans, it was sometimes made explicit that they were not a management priority,

but were likely to benefit from conservation actions aimed at other values. For example, the Dambimangari Healthy Country Plan 2012-2022 (2012) lists nine management priorities focused on culturally important plants, animals, places and burning practices, then states “while we are looking after our nine most important things we are looking after these threatened species.” In this plan, ‘collaborative’ research focused on threatened species was seen to disempower Indigenous partners, because their participation was limited to contributing knowledge to benefit Western conservation objectives, rather than involvement in initial decisions about which conservation values research should focus on:

Dambimangari Rangers have worked with WWF and marine scientists to find out how many of these dolphins there are and if they are a threatened species. Our traditional knowledge of the tides, currents and seas help us when we are looking for jigeedany [dolphins] and we have learned how to record our sightings from the scientists. In the past, our Rangers worked with Western scientists who were studying dolphins. We would like them to be more involved with researchers in joint projects that are meaningful for us as well.



Conservation areas such as Kakadu National Park are important cultural landscapes sustaining species that are significant to both Indigenous and agency managers © Tom Duncan



Estuarine crocodile *Crocodylus porosus* is a culturally significant species in parts of northern Australia © Tom Duncan

In agency co-governance regime plans, significant species were generally threatened species, and Indigenous participation was often not mentioned in management strategies. Some plans also included culturally significant species and prioritised recovery of species that are both culturally significant and threatened species (Ikara-Flinders Ranges National Park Management Plan 2017). Others gave Indigenous partners greater control in significant species management by requiring the consent of Indigenous partners before permits to research particular species were approved (Vulkathunha-Gammon Ranges National Park 2006). One plan explicitly emphasised the importance of considering biodiversity as one element of a cultural landscape: “Biodiversity, including threatened species and natural resources, [was] recorded as a component of the cultural landscape and management of these assets was considered as part of the management of the cultural landscape” (Border Ranges Rainforest Biodiversity Management Plan 2010).

DISCUSSION

Our results show that agencies and local Indigenous communities differ in their perceptions of conservation values and their respective roles in managing those values. Agencies perceive clearly defined boundaries between cultural heritage, significant species and fire

management, and the currently low engagement rates of local Indigenous communities in the latter two categories might be explained by agencies perceiving cultural heritage to be the most important focus of Indigenous participation. This would align with Western conservation paradigms which generally perceive ‘nature’ and ‘culture’ as separable constructs with their own values and associated management strategies (Harmon, 2007), and ‘cultural heritage’ as pertaining exclusively to particular sites or artefacts considered to have static, historical significance (Jackson, 2006). Carter (2010) argues that these perceptions remove cultural meaning and force local Indigenous communities to conform to agency and scientific discourses in conservation management.

Local Indigenous communities perceive their role in conservation management as much more than protection of particular cultural heritage sites, with maintenance of cultural heritage values encompassing the wider cultural landscape and associated indicators of cultural health, such as language or transmission of knowledge (Smyth & Beeron, 2001; Venn & Quiggin, 2006). For Indigenous Peoples, the ability to sustain cultural landscapes relies on the capacity to participate in all aspects of conservation management. Managing fire and significant species are cultural responsibilities which cannot be separated from other elements of the

environment (Garibaldi & Turner, 2004; Lynam et al., 2007; McGregor et al., 2010; Yibarbuk et al., 2001). Agency planning regimes that allow local Indigenous communities a role in one management area while excluding them from other areas can therefore be seen as a barrier to exercising their cultural rights and responsibilities (Langton, 2009). The impact of this marginalisation can be exacerbated because ‘natural’ elements are often prioritised over ‘cultural’ elements in protected area management (Hill et al., 1999). Governance structures which impede local Indigenous communities from undertaking holistic conservation management may also limit the capacity of agency-managed areas to achieve their own conservation objectives. In many cases, Indigenous land management practices have been described as synergistic with those of Western conservation managers, even where the stated objectives of land management are different from Indigenous perspectives. For example, Indigenous fire managers in Australia have a range of motives for carrying out burning activities, but do not necessarily identify maintenance of biodiversity among them (Yibarbuk et al., 2001). Nonetheless, these fire regimes have been associated with high levels of biodiversity and Western conservation managers seek to emulate Indigenous fire management practices in some conservation areas (Franklin et al., 2008).

Even where agencies do seek to engage Indigenous collaborators in management of significant species and fire, our results show that participation can be restricted in agency governance and (to a lesser extent) agency co-governance regimes to contributing knowledge and labour to fulfil agency-defined conservation objectives. While participation on these terms can be viewed positively by the local Indigenous communities involved (e.g. Brennan et al., 2012; Hoffmann et al., 2012), researchers have argued that separating Indigenous knowledge systems from Indigenous conservation objectives repudiates the validity of the knowledge systems and leads to subjugation rather than empowerment of local Indigenous communities (Coombes, 2007; Hill et al., 1999). In our case study, analysis of plans shows that, while Indigenous co-governance structures increase the capacity of Indigenous partners to control aspects of what type of knowledge is sought and how it is used in management, in some cases research activities in these conservation areas were still based on Western conservation values of questionable relevance to Indigenous collaborators. Even where co-management regimes are developed that give Indigenous collaborators greater power in decision-making, the institutional structures in which planning takes place can nonetheless give precedence to agency

worldviews and knowledge systems (Nadasdy, 2005). This shows that even where Indigenous collaborators benefit from access to procedural equity, the institutional and political context in which management occurs can act to marginalise Indigenous conservation worldviews.

Differences in the perception of significant species suggest that the existing political and legislative context in which threatened species are prioritised for management may also limit Indigenous autonomy in defining conservation values. Agency regime plans generally identify biodiversity values aligned with those in international and national policy and legislation. In Australia, these mechanisms have long required Indigenous values to be considered in biodiversity management. For example, Australia’s Threatened Species Strategy outlines the importance of working with local Indigenous communities and incorporating their knowledge to conserve threatened species, and includes commitments to prioritise management of threatened species that are also culturally important (Department of the Environment, 2010). While these commitments devolve some level of control in planning to Indigenous peoples, they also operate within a conservation paradigm with implicit assumptions about which elements of biodiversity are most important. Because the conservation value has been defined on Western terms as ‘threatened species’, Indigenous autonomy is confined to operating within this construct.

This presents potential challenges to Indigenous conservation paradigms. Classificatory systems among cultures vary, so the plant or animal that is defined as a discrete entity (i.e. a ‘species’) under Western taxonomic systems and in legislation may be defined differently by local Indigenous communities (Puruntatameri et al., 2001). By definition, threatened species are rare and may not be observed frequently or even known by local Indigenous communities (Garnett & Woinarski, 2007). According to Rose (1995, p.92), singling out particular species for management attention may in itself be a problem, because “ethics and value judgements which support playing favourites with some species over others do not fit easily into the Aboriginal world view”. In our case study, Indigenous co-governance regimes represented better opportunities for local Indigenous communities to access the procedural equity that allowed them to define which species or groups of species were significant than agency governance or agency co-governance regimes. Similar opportunities have been noted elsewhere in Australia. Indigenous land managers in a central Australian IPA were able to prioritise management of culturally important game animals despite the fact that they were of little



Local Indigenous communities seek to engage in management of cultural heritage, significant species and fire © Tom Duncan

significance to Western conservationists because they were considered 'common' (Wilson & Woodrow, 2009). In contrast, in the management plan for a jointly managed National Park, agency perceptions of Banteng *Bos javanicus* as a 'feral' species which may damage biodiversity values took precedence over the values of Indigenous collaborators, who considered Banteng to be a significant species and legitimate element of the cultural landscape (deKoninck, 2005).

Even in cases where there is consensus between Indigenous and agency conservation managers about which species are management priorities, the types of conservation actions considered appropriate often differ. Indigenous Peoples often consider the taking of significant species for food, medicine or other uses as essential to sustaining the existence of that species and the health of the wider cultural landscape (Davies et al., 1999; Roberts et al., 1995). Because global and national conservation legislation and policy often emphasise the need to 'protect' significant species, as do agency governance regimes in our sample bioregions, this presents a potential point of conflict in co-governance

partnerships. The likelihood of conflict increases when the species being used as a resource is also a threatened species (Nurse-Bray, 2009).

CONCLUSIONS

Our case study demonstrates that despite international policy commitments, agency conservation planning processes often consider Indigenous participation outside of cultural heritage management to be limited to inclusion of Indigenous labour or knowledge to achieve agency conservation objectives. Our results suggest that Indigenous co-governance regimes currently provide better opportunities for local Indigenous communities to access procedural equity than the other governance regimes considered in our analysis. One of the positive implications of our research is that, given the significant amount of land in Australia designated as Indigenous Protected Areas (Renwick et al., 2017), Indigenous communities are likely to have authority in management of a significant (and increasing) proportion of the nation's conservation estate.

Indigenous co-governance regimes are an essential component in lifting rates of Indigenous engagement

and enhancing equity in governance, but successfully achieving the commitments set out in policy will also require other changes to be made. Governments are likely to continue to hold responsibility for most conservation management in the future, and the capacity for Indigenous Peoples to participate in Indigenous co-governance regimes depends strongly on short-term and unpredictable levels of government funding (Davies et al., 2013; Langton et al., 2005). In settings outside Australia, the potential to develop Indigenous co-governance regimes relies on advantageous political and social contexts and secure land tenure, preconditions which are unevenly distributed.

Local Indigenous communities have used innovative methods to overcome these challenges and shape the planning discourse in agency planning regimes. For example, Hill et al. (1999) describe how a local Indigenous community withheld knowledge from collaborators and used development of a fire protocol to gain power and extend their participation in fire and significant species management. In another case, a local Indigenous community transformed the discourse surrounding cultural heritage listing to include an integrated notion of biocultural diversity (Hill et al., 2011). In these instances, local Indigenous communities were able to use a greater share of procedural equity to assert at least some of their aspirations for conservation management despite not having the benefits that an Indigenous co-governance regime planning structure provides.

There is also an onus on agencies to incorporate the structural and attitudinal changes likely to lead to increased equity into their planning regimes. According to Adams (2004, p.8), this requires a willingness to recognise the institutional and conceptual constraints under which Indigenous peoples currently participate:

If however, the only real meeting places are created 'after' Aboriginal people have regained rights to land, the potential is limited: this perpetuates the situation where Aboriginal people 'force' others to the negotiating table by law or judicial decision. It is processes of structural and attitudinal change which are necessary to create the opportunity for new meeting places – recognition spaces – across the landscape.

Our research suggests that these 'meeting places' remain elusive in agency governance regime conservation areas in Australia, and emphasises the need for innovative conservation management practices that may help to bridge the gap between policy commitments and recognition of Indigenous Peoples' conservation priorities. Potentially useful approaches

include an emphasis on monitoring cultural well-being along with biodiversity (Caillon et al., 2017), consideration of the planning structures used in IPA plans, which emphasise linkages between people, places and plants and animals (Davies et al., 2013), and far greater emphasis on following respectful and culturally appropriate process when negotiating joint management (Stacey et al., 2013). Conceptual shifts which begin to see Western knowledge systems as being incorporated into long established and situated Indigenous management practices, rather than Western conservation management 'bringing in' Indigenous knowledges, may also be useful in developing more equitable collaborative spaces (Muir et al., 2010). It is through applying these structural and attitudinal changes in combination with Indigenous governance structures that recognition of Indigenous rights in conservation management will be ultimately realised.

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SUPPLEMENTARY ONLINE MATERIAL

Indigenous land tenure in sample bioregions (provided by Ian Leiper)

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RESUMEN

Diversos instrumentos sobre políticas y regímenes de gobernanza internacionales, nacionales y locales reconocen el conocimiento de los pueblos indígenas y las comunidades locales como una plataforma clave para la gestión de la biodiversidad y los ecosistemas, pero la materialización de estos compromisos en la negociación de prioridades de conservación con comunidades locales adecuadamente empoderadas sigue siendo inconsistente. Con base en una revisión de los planes de gestión de las áreas de conservación en las bioregiones australianas identificadas con un alto potencial para la participación de las poblaciones indígenas en la gestión de especies amenazadas, examinamos cómo el potencial de las comunidades indígenas locales para perseguir sus objetivos de conservación y el grado de participación en la gestión de las especies importantes, el patrimonio cultural y los incendios, están influenciados por diferentes regímenes de gobernanza ambiental. Descubrimos que en la actualidad las comunidades indígenas tienen más posibilidades de participar en la gestión del patrimonio cultural que en la gestión de especies o incendios, a pesar de la evidencia de que las comunidades indígenas buscan participar en la gestión de todos los aspectos de sus bienes tradicionales. Las prioridades en la gestión de especies en los planes sobre regímenes de cogobernanza impulsados por los indígenas se centran en especies de importancia cultural en lugar de especies amenazadas. Concluimos que el potencial actual de las comunidades indígenas locales para participar en la gestión de la conservación en términos equitativos depende del establecimiento de regímenes de cogobernanza impulsados por los indígenas, y argumentamos que para elevar los niveles de participación de los pueblos indígenas en los regímenes de gobernanza de las agencias se requiere un mayor reconocimiento por parte de las agencias de las cosmovisiones indígenas en la planificación de enfoques de conservación.

RÉSUMÉ

Une large palette d'initiatives politiques et de régimes de gouvernance aux niveaux international, national et local, reconnaissent que les savoirs des peuples autochtones et locaux représentent une plate-forme essentielle pour la gestion de la biodiversité et des écosystèmes, mais la transformation de cette reconnaissance en négociations avec des communautés locales autour des priorités de conservation reste approximative et irrégulière. En se basant sur un examen des plans de gestion des zones de conservation dans les biorégions australiennes ayant un potentiel élevé pour l'engagement indigène dans la gestion des espèces menacées, nous avons analysé l'influence qu'exercent des différents régimes de gouvernance environnementale sur le potentiel des communautés autochtones locales à poursuivre leurs objectifs de conservation, et le degré de leur implication dans la gestion des espèces importantes, du patrimoine culturel et des incendies. Nous avons constaté que les communautés autochtones disposent d'une plus grande latitude dans la participation à la gestion du patrimoine culturel que dans la participation concrète à la gestion des espèces ou des incendies, malgré leur volonté manifeste de collaborer à la gestion de tous les aspects de leurs domaines traditionnels. Il s'avère qu'en cas de co-gouvernance avec les autochtones, les priorités de gestion des espèces sont centrées sur les espèces d'importance culturelle plutôt que sur les espèces menacées. Nous concluons que la possibilité pour les communautés autochtones locales de participer de manière équitable à la gestion de la conservation dépend de la mise en place de régimes de co-gouvernance dirigés par les autochtones. Nous faisons également valoir que pour améliorer le niveau de participation des peuples autochtones, les régimes de gouvernance institutionnelle doivent mieux reconnaître les visions du monde autochtones lors des initiatives de planification de la conservation.