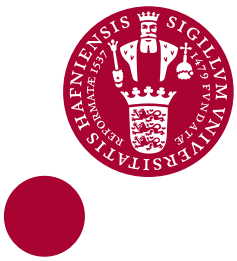

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Short Communication

Protected areas to deliver biodiversity need management effectiveness and equity

Noelia Zafra-Calvo [a, b, *], Jonas Geldmann [a, c]

[a] Center for Macroecology, Evolution and Climate, Natural History Museum of Denmark, University of Copenhagen, Universitetsparken 15, 2100, Copenhagen E, Denmark
[b] Basque Centre for Climate Change (BC3), Edificio Sede Nº 1, Planta 1a; Parque Científico de UPV/EHU, Barrio Sarriena s/n, 48940, Leioa, Bizkaia, Spain
[c] Conservation Science Group, Department of Zoology, University of Cambridge, Downing St., Cambridge, CB2 3EJ, UK

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ABSTRACT

It is widely recognized in science, policy, and practice that protected areas (PAs) that are equitably and effectively managed are essential for halting biodiversity loss. However, our understanding of the relationships between management effectiveness and equity remains weak. Here, we investigate potential synergies and trade-offs between management and equity as well as how they can work together to reduce human pressure in PAs. We then examine the potential of existing global datasets on effectiveness, equity, and human pressure to help inform international policy processes. Our preliminary findings show a negative association between well-defined and sound managed PAs and how satisfied are local people about the decisions related to the management of the PA, reinforcing study of cases that found conflicts in top-down established and managed PAs. We find, however, no association between management effectiveness and social equity with an increasing human pressure. We find only a limited overlap in global databases on management effectiveness, social equity, and human pressure (n = 33). Thus, our results highlight the need to increase the number of PAs with appropriate data about management effectiveness, equity and human pressure to inform policy processes. Without such data, it will be difficult to suggest in honest new quantitative targets for the quality of PAs and Other Effective Area-based Conservation Measures post-2020.

1. Introduction

Protected areas (PAs) have become the bedrock of conservation in many parts of the world and now cover ca. 15% of earth's terrestrial surface and 7% of the global oceans (UNEP-WCMC & IUCN, 2018). However, it is increasingly recognized that coverage alone is not enough, and that quality not quantity is needed in PAs to reduce human pressure and improve biodiversity (Watson et al., 2014). Additionally, there is increasing focus on the role of PAs in supporting local livelihood both as a means to protect biodiversity and as a mean in itself. This requirement, of PAs to deliver conservation outcomes across the biological and socio-economic strata, is also acknowledged in the Convention on Biological Diversity's (CBD) Aichi

* Corresponding author. Basque Centre for Climate Change (BC3), Edificio Sede Nº 1, Planta 1a, Parque Científico de UPV/EHU, Barrio Sarriena s/n, 48940, Leioa, Bizkaia, Spain.
E-mail address: noelia.zafracalvo@bc3research.org (N. Zafra-Calvo).

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Biodiversity Target 11; which require PAs to be 'effectively and equitably' managed (Convention on Biological Diversity, 2010). Understanding to what extent PAs are delivering across these multiple objectives, as well as how to promote synergies, is therefore a key question in conservation science, policy and practice.

The efficacy of PAs in achieving outcomes is a function of whether management is producing expected measurable 'outputs' in terms of effectiveness and equity, and whether these are delivering anticipated 'outcomes' for the site (Hockings et al., 2006) (Fig. 1; inspired by Ostrom et al. 2009, Spangenberg et al., 2009, Pascual et al., 2017 and Isbell et al., 2017). Effective management of PAs is about what is done to achieve the overall objectives, and includes defining and allocating tasks, responsibilities and accountabilities regarding capacity, resources, enforcement and decisions. In contrast to effectiveness, equity in PA management is an emerging concept that remains challenging to define (Friedman et al., 2018) and it has scarcely been integrated into PA assessment efforts (Moreaux et al., 2018). Equity — social equity in full — is multi-layered and basically means fairness (Franks et al. 2018). It draws on environmental justice concepts and it is generally understood through three dimensions (McDermott et al., 2013; Pascual et al., 2014; Zafra-Calvo et al., 2017): (1) recognition; which is about acknowledging and respecting rights and the diversity of identities, knowledge systems, values and institutions of different actors; (2) procedure; which is about participation of actors in decision making, transparency, accountability, and processes for dispute resolution; and (3) distribution; which is about the allocation of benefits and costs across the set of actors, and, how the costs/burdens experienced by some actors are mitigated.

Governance is about power, institutions, relationships and accountability and shares properties with social equity on issues of recognition and procedures (Lockwood, 2010; Shields et al., 2016). The distributional dimension of social equity, closely relates to human well-being in both the equitable distribution of burdens and benefits derived from nature's contributions to people and perceived as affecting people's quality of life and then, social equity is also a critical feature to achieve conservation outcomes (de Lange et al., 2016; Corrigan et al., 2017). Conservation outcome is a multi-dimensional concept. Here we use it to refers to both improved well-being and improved ecological conditions (i.e. a reduction in human pressure and an increase in ecological outcomes) as a consequence of the PA (Eklund and Cabeza, 2017) (dotted box in Fig. 1). Whether PAs achieve conservation outcomes is particularly dependent of the context within the PA and of having the precise enabling conditions that could lead reaching a given conservation outcome.

The contribution of management to the effectiveness of a PA is not well documented with the exception of studies showing the importance of staffing (e.g. Gill et al., 2017; Geldmann et al., 2018), or a proper system of law enforcement (e.g. Kuempel et al., 2017) (arrow 1 in Fig. 1). Recent studies have also investigated how different governance regimes can contribute to decrease deforestation (Schleicher et al., 2017) or maintain species populations (Barnes et al., 2016; Amano et al. 2018; Hill et al., 2020) (arrow 2 in Fig. 1). PAs from the threats posed by human activity will by definition inhibit some human actions (Pullin et al., 2013). Better studied have been the intended and unintended social consequences of PAs on wellbeing by inhibiting human actions (Oldekop et al., 2016; Jones et al., 2017, Naidoo et al., 2019) and how this in turn can foster or hinder

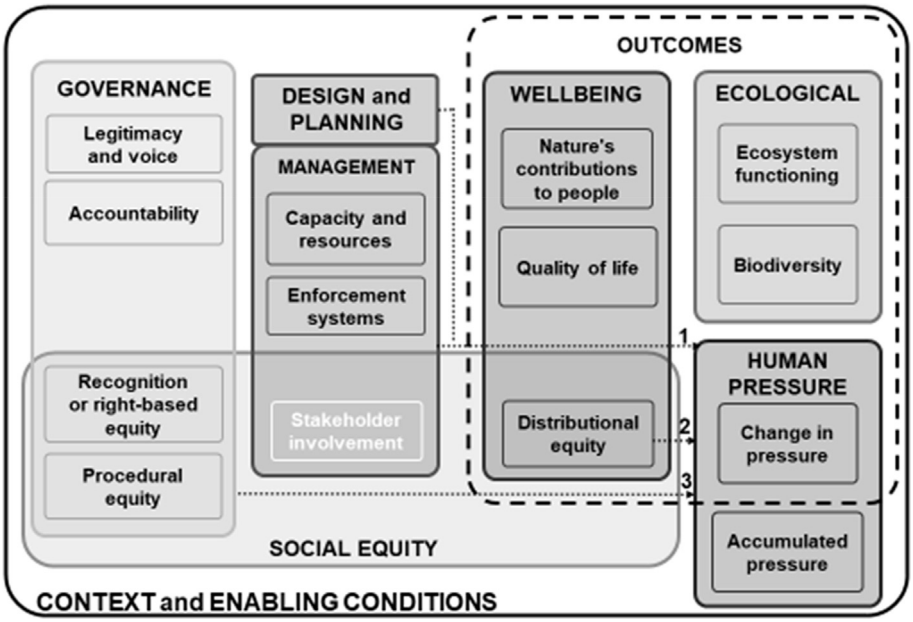

Fig. 1. Protected area factors (governance; design, planning and management; social equity) promoting or hinder achieving conservation outcomes (wellbeing, ecological, human pressure). They are enabled or constrained by contextual factors (context and enabling conditions). The main characteristics of the factors are defined (e.g. management: capacity resources, enforcement systems and stakeholder involvement). Literature has identified potential overlap between management effectiveness and social equity (white box) and links between management (arrow 1), distributional equity (arrow 2), and recognition and good governance processes (arrow 3) with changes in human pressure.

conservation outcomes (arrow 3 in Fig. 1) (Bennett et al., 2019). Studies show that the lack of social equity considerations and potential pre-existing conflicts in the management of PAs can lead to non-compliance of local stakeholders with conservation goals, and in turn, an increasing human pressure over natural resources (e.g. poaching; Law et al., 2017). Conversely, there are also examples of successful conservation of species, such as the African elephant, by including equity considerations and involving local communities in the vicinity of PAs (Cooney et al., 2017).

Although a growing body of literature has investigated how management effectiveness and equity can and often do support or hinder the delivery of conservation outcomes, there is still a lack of understanding of how specific characteristic of management or equity and their synergies and trade-offs promote or compete with the delivery of outcomes.

Here, we explore first the relationship between management effectiveness and social equity to assess where and to what extent strong management and equity coincide or collide. We then test the three-way relationship between management effectiveness, social equity, and change in human pressure in PAs and identify potential synergies and trade-offs between management effectiveness and social equity to achieve conservation outcomes. We take advantage of the large amount of data now held in global repositories about management effectiveness, social equity and human pressure to perform a hypothesis-exploration analysis in the PAs where global available databases overlap. Finally, we discuss the main challenges management of PAs face in its interplay with social equity and human pressure, as well as discuss the need for better data to assess the role of quality PAs in achieving global targets for conserving biodiversity.

2. Methods

2.1. Data

2.1.1. Management

The effectiveness of management in PAs can be measured in a variety of ways depending on the specific objectives of a PA and the scope of the assessment (Mascia et al. 2014, 2017). We used the Management Effectiveness Tracking Tool (METT) for which a global database (GD-METT) has been compiled, containing more than 4000 assessments (Coad et al., 2015). The METT collects information on objectives of, threats to, and designation of the PA as well as evaluating the adequacy of 30 elements of PA management. We grouped the questions based on Ostrom (1990) framework for governance of common pool resources and the IUCN World Commission on Protected Areas (WCPA) management effectiveness framework (Hockings et al., 2006) using the methodology described in Geldmann et al. (2019). This approach resulted in four different dimensions of management measured in each PA: 1) Design and Planning (DaP), relating to the legal status, design and identification of objectives of the PA; 2) Capacity and Resources (CaR), covering the adequacy of staffing, budgets and equipment; 3) Monitoring and Enforcement Systems (MaE), summarizing the effectiveness of monitoring and law enforcement; and 4) Decision-Making Arrangements (DMD), reflecting the engagement of local stakeholders in management decisions.

2.1.2. Equity

We used data of ten criteria of multidimensional social equity for each PA (Schlosberg, 2007; Sikor et al., 2014; Zafra-Calvo et al., 2017): sharing of benefits (Benefits), distribution of burdens (Burdens); accountability (Accountability), access to justice (AccessToJustice), transparency (Transparency), participation in decision-making (DecisionMaking); Free, prior and informed consent mechanisms (FPIC); recognition of cultural diversity and values (Culture), respect for statutory and customary rights (Rights), and recognition of local traditional knowledge systems (Knowledge). This dataset contains 241 assessments made through a targeted questionnaire to managers and other stakeholders involved in the management of 225 PAs from 88 countries (see the questionnaire and details about respondents in Zafra-Calvo et al., 2019).

2.1.3. Human pressure

To assess the change in human pressure inside PAs we looked to the change in Human Footprint (HF) between 1993 and 2009. The HF is a composite 1 km^2 global terrestrial data-layer integrating land use, human infrastructure, human population density and nightlights ranging between 0 (no human pressure) and 50 (highest possible human pressure) (Venter et al., 2016). Based on ground-truthing of the data that informs the HF any value equal to or higher than four is considered not intact and it has been suggested that using this threshold is appropriate when estimating changes in human pressure (Di Marco et al., 2018; Mappin et al., 2019). We thus, converted the HF data into a categorical variable of converted (i.e. pixels with $HF \geq 4$) and intact (i.e. pixels with $HF < 4$). We then used zonal statistics to calculate the proportion of pixels in any PA that had undergone conversion from intact to converted between 1993 and 2009.

2.2. Data analysis

We explored the main hypotheses about the relationship between management effectiveness, social equity and human pressure found in the literature by using the available global databases described in 2.1. We first tested the hypothesis of whether sound management effectiveness imply low equity, that is, there is a potential trade-off in achieving effectively and equitably managed PAs (focus our attention in stakeholder involvement, white box in Fig. 1). We tested the rank-correlations

between all combinations of METT scores related to its four dimensions and social equity scores related to its ten criteria. We explored a second hypothesis; whether low METT score (arrow 1 in Fig. 1) or low scores in social equity (arrows 2 and 3 in Fig. 1) increase human pressure. We also tested the rank-correlations between the METT scores in its four dimensions, social equity scores related to its ten criteria, and change in human footprint. We used Spearman correlation (rcorr function in the package hmisc of R (R core team, 2013)) to test both hypotheses. We chose to use non-parametric rank-analysis because the number of PAs in our sample (n = 33) from an almost equal number of countries (n = 27) as well as high number of competing explanatory variables across the management and equity datasets made more advanced models (e.g. Mixed Effects Model with country as random effect) very difficult. See details about the description of the variables and full dataset used in Appendix A.

3. Results

Our sample of PAs was predominantly large and old PAs (n = 33). It was dominated by Latin American (n = 16; 11 countries), African and Asian (n = 12, 11 countries) and Eastern Europe (n = 5, 5 countries) and contained no PAs from North America, Western Europe or Australia.

3.1. Hypothesis 1 (white box in Fig. 1): High scores in management effectiveness imply low scores in equitably managed PAs

We found a significant negative relationship between DaP and equitable decision-making processes ($rs = -0.36$, $P = 0.04$) (Fig. 2). Thus, adequately designed and planned PAs with well-defined conservation goals in place and sound management effectiveness, were associated with people being unsatisfied about how decisions related to the management of the PA are taken.

3.2. Hypothesis 2 (arrows 1, 2 and 3 in Fig. 1): Low scores in management capacity or low scores in social equity entail high human pressure

We did not find a significant relationship between equitably and effectively managed PAs and achievement of conservation outcomes, such as low human pressure, in our sample (Fig. 2).

4. Discussion

Our preliminary exploration about the relationships between management effectiveness and social equity revealed findings that could require further attention. Firstly, our findings show that PAs with appropriate design and planning are negatively associated to how satisfied are local stakeholders with their involvement in the management and the decisions taken (white box in Fig. 1). This suggests that PAs that are managed top-down, probably affording the PA authorities greater control, might at the same time excluding local stakeholders. Management can, in-it-self, be viewed as restrictive on local communities, when it reduces their rights to an area and ability to sustain themselves. Even the action of PA designation is by some seen as a form of land-grabbing (Fairhead et al., 2012). In many cases, decisions regarding PAs fails in involving all stakeholders' views and preferences in the decision-making processes (commonly because they are not recognized as "relevant" and they are marginalized and excluded). This may generate disputes involving the use, access and ownership of natural resources by stakeholders who have different power and interests and defend different conceptions regarding the management of nature (Redpath et al., 2013). This suggests that effective conflict management and long-term conservation will be enhanced by better integration of local stakeholders' vision and preferences in decisions about PAs management (Zafra-Calvo and Moreno-Peñaranda, 2018).

We found no evidence of an association of management effectiveness or social equity with human pressure (arrows 1, 2 and 3 in Fig. 1). We do not suggest that no such association can occur, rather that the relatively small number of PAs with overlaps between our three datasets makes it difficult to assess. There are great examples in the literature of how management effectiveness can help to promote biodiversity conservation (Leader-Williams & Albon, 1988, Laurance et al., 2012, Geldmann et al., 2013; Gill et al., 2017; Geldmann et al., 2018). Likewise, social equity has been shown to support more inclusive conservation decisions leading to better outcomes (Bennett and Dearden, 2014; Oldekop et al., 2016). However, the specific mechanism by which this works is often complicated and context specific making it difficult to assess with smaller dataset or without carefully designed experimental setups (Baylis et al., 2016). In addition, the geographical scope of our study across 27 countries with potential regional or country level interpretations of certain concepts related to management and equity can influence the correlational analysis. However, we believe this issue is minimized by using the same standardized systems for capturing equity and management effectiveness respectively across our entire sample.

In this paper we outline an important research question and present a novel framework for addressing the interaction between social equity and management in delivering conservation outcomes. However, our results also show the limited availability of data to answer this seminal question in conservation. This lack of relevant knowledge may hamper our opportunities to formulate actions to halt biodiversity loss while also addressing livelihood challenges in and around PAs. We see a need for a global dataset for PAs that includes information about all the factors contributing to conservation success (such as governance characteristics of legitimacy and voice or accountability; more detailed data about the establishment of

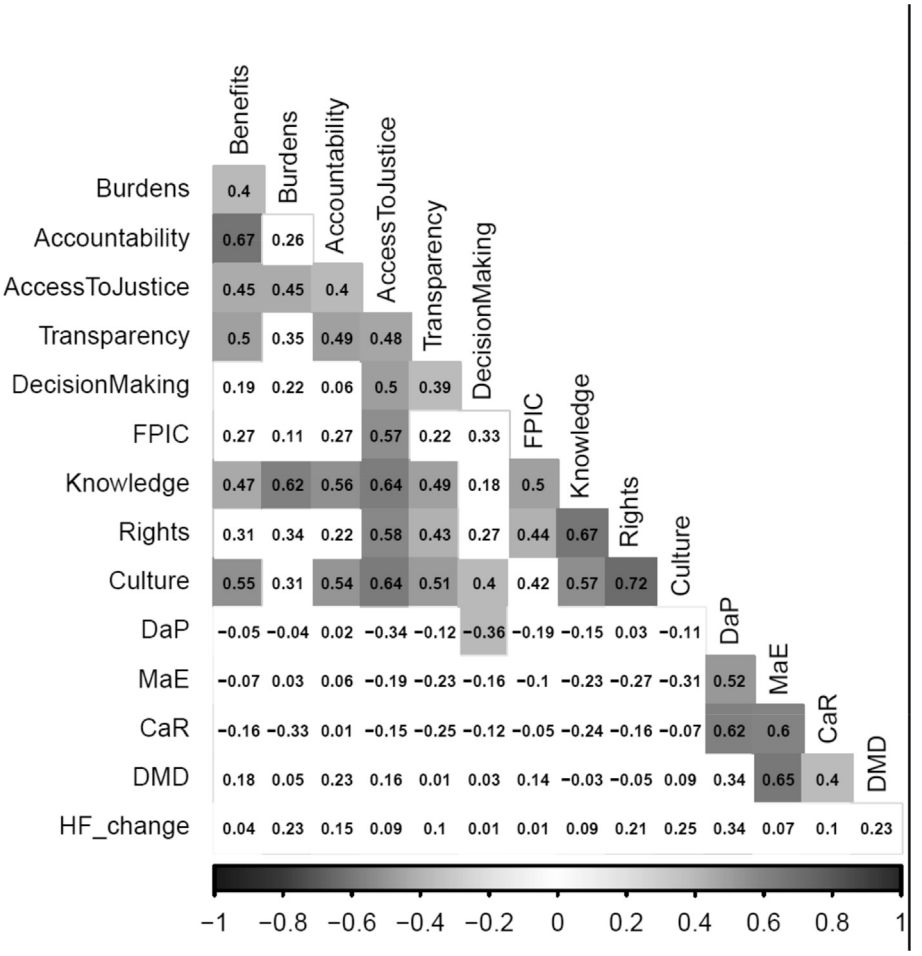

Fig. 2. Spearman correlation coefficients showing the association between the main criteria of social equity - sharing of benefits (Benefits), distribution of burdens (Burdens); accountability (Accountability), access to justice (AccessToJustice), transparency (Transparency), participation in decision-making (DecisionMaking); Free, prior and informed consent mechanisms (FPIC); recognition of cultural diversity and values (Culture), respect for statutory and customary rights (Rights), and recognition of local traditional knowledge systems (Knowledge)-, management effectiveness- DaP (Design and Planning), CaR (Capacity and Resources), MaE (Monitoring and Enforcement Systems), DMD (Decision-Making Arrangements) - and human footprint change in PAs (n = 33). The values in the squares show the correlation coefficients (rs). Where a statistically significant association exists ($P < 0.05$), squares are colored in grey shades (higher correlation is shown in darker grey). Where an association is not statistically significant, squares are colored in white.

PAs) and a targeted assessment tool to gather these data. This should become a regular part of most larger donor organizations program evaluations, who has the potential to be leader in this field (Craigie et al., 2015). Likewise, countries should integrate a more holistic approach in assessments of their PA networks to capture information on both socio-economic and management aspects as well as relevant conservation outcomes. A targeted effort by countries and donors that integrates the institutional, social and ecological complexity of PAs could help to track progress of multifunctional and quality of PAs beyond 2020 and ensure PAs remain fit-for-purpose in the decades to come.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.gecco.2020.e01026.

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