**LETTER**

The prevalence, characteristics and effectiveness of Aichi Target 11's “other effective area-based conservation measures” (OECMs) in Key Biodiversity Areas

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Abstract

Aichi Target 11 of the CBD Strategic Plan for Biodiversity commits countries to the effective conservation of areas of importance for biodiversity, through protected areas and “other effective area-based conservation measures” (OECMs). However, the prevalence and characteristics of OECMs are poorly known, particularly in sites of importance for biodiversity. We assess the prevalence of potential OECMs in 740 terrestrial Key Biodiversity Areas (KBAs) outside known or mapped protected areas across ten countries. A majority of unprotected KBAs (76.5%) were at least partly covered by one or more potential OECMs. The conservation of ecosystem services or biodiversity was a stated management aim in 73% of these OECMs. Local or central government bodies managed the highest number of potential OECMs, followed by local and indigenous communities and private landowners. There was no difference

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between unprotected KBAs with or without OECMs in forest loss or in a number of state-pressure-response metrics.

KEY WORDS

Aichi Targets, CBD, ecosystem services, OECMs, protected areas

1 | INTRODUCTION

In 2010, the Conference of the Parties to the Convention on Biological Diversity (CBD) adopted the Aichi Biodiversity Targets as part of the *Strategic Plan for Biodiversity 2011–2020*. Aichi Target 11 states that “By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity are conserved through protected areas *and other effective area-based conservation measures*...” (emphasis added). However, no definition was offered for “other effective area-based conservation measures,” now more commonly referred to as OECMs (Jonas, Barbuto, Jonas, Kothari, & Nelson, 2014) but for which the more intuitive term “conserved areas” has been proposed (Jonas et al., 2017). This lack of definition hinders Parties to the CBD from reaching or exceeding their goals (Gannon et al., 2017; Jonas & Lucas, 2013; Jonas et al., 2014; MacKinnon et al., 2015; Woodley et al., 2012). The IUCN World Commission on Protected Areas (WCPA) established a Task Force to develop a draft definition of OECMs and to provide advice on their identification so that sites benefitting from OECMs can be identified consistently and brought into required reporting processes (IUCN-WCPA, 2018a), thus giving them formal recognition and support. In November 2018 the 14th Conference of the Parties of the CBD adopted the definition of an OECM as: “a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socioeconomic, and other locally relevant values.” This definition is intended to capture sites under a wide range of governance and management systems (including privately owned areas) which do not meet the IUCN definition of protected areas but which contribute to biodiversity conservation (IUCN-WCPA, 2018b, Jonas et al., 2018; Mitchell, Fitzsimons, Stevens, & Wright, 2018). Note, however, that the definition of protected areas is itself not always consistently applied; for example, privately protected areas are recognized as protected areas in some countries but not in others, and they may be greatly under-represented in lists of protected areas (Bingham et al., 2017). Importantly, the definition of OECMs does not require that the conservation of biodiversity is the primary management objective but rather that OECMs are defined by con-

servation outcomes, a key difference from protected areas as defined by IUCN (Jonas et al., 2018; Woodley et al., 2012). The definition currently lacks quantitative thresholds or other metrics with which to assess sites as OECMs, and formal processes for identifying, listing, and reporting on OECMs are currently in development.

OECMs may complement wider conservation initiatives by increasing the ecological representativeness and connectivity of conservation area networks, foster collaborations between conservation organizations and other stakeholders, and enhance engagement with landowners to protect economically important natural resources (Diz et al., 2017; Jonas et al., 2018; Shwartz et al., 2017). Around a quarter of the Earth’s terrestrial area, intersecting about 40% of all terrestrial protected areas and ecologically intact landscapes, is managed or tenured by Indigenous Peoples (Garnett et al., 2018), and OECMs may be an appropriate way of recognizing and supporting their contribution to biodiversity conservation outside the protected area network. OECMs also may be important in filling identified shortfalls in coverage by the protected area network (Butchart et al., 2015; Gannon et al., 2017; Juffe-Bignoli et al., 2016; Laffoley et al., 2017).

However, the extent to which potential OECMs overlap with areas of importance for biodiversity remains unknown. We therefore undertook the first assessment of the prevalence and characteristics of potential OECMs in a large sample of Key Biodiversity Areas (KBAs) spread across ten countries. KBAs are sites of importance for the global persistence of biodiversity, identified using quantitative criteria that have recently been harmonized into a common global standard (IUCN, 2016). Over 15,000 KBAs have been identified to date, in terrestrial, freshwater and marine environments worldwide (BirdLife International, 2018).

2 | METHODS

We selected ten countries in which to assess the extent and characteristics of potential OECMs in KBAs. We aimed for wide coverage, both spatially and socioeconomically, and focused our search on countries in which ground-based monitoring data have been collected using a defined protocol (BirdLife International, 2006) through the Important Bird and Biodiversity Area (IBA) programme. IBAs are sites of

importance for the long term conservation of birds, and comprise the majority of sites in the KBA inventory (Donald et al., 2019). The 10 countries were Australia (survey undertaken by BirdLife Australia), Bolivia (Asociacion Armonia), Canada (Bird Studies Canada), Ecuador (Aves y Conservación), India (Bombay Natural History Society), Indonesia (Burung Indonesia), Kazakhstan (Association for the Conservation of Biodiversity in Kazakhstan; ACBK), Kenya (Nature Kenya), Philippines (Haribon Foundation), and South Africa (BirdLife South Africa). Using their knowledge of the KBAs in each country, their contacts with various stakeholders, such as NGOs, government and Local Conservation Groups (groups of local stakeholders established by BirdLife Partners around many KBAs to oversee their conservation), these organizations undertook an assessment of some or all of the unprotected terrestrial KBAs in their countries using a pre-defined set of questions (further details given in Supporting Information, Appendix S1, Table S1). A high proportion of KBAs in these countries are also IBAs, which were identified, documented and delineated by the project partners themselves. The surveys were designed to capture information on (i) the prevalence and characteristics of any potential OECMs present across all or part of each KBA, (ii) whether, if potential OECMs were present in the KBA, the site would be better conserved under the present system or as a protected area as defined by IUCN, and (iii) whether KBAs currently lacking protection or potential OECMs would be better conserved by one or the other.

Part of the definition of OECMs is that they are not protected areas, so the first step was to remove KBAs that are already covered by protected areas. This was determined by a GIS intersection of KBA polygons from the World Database of KBAs (WDKBA; <http://www.keybiodiversityareas.org/home>) with spatial data from the WDPA (<https://protected-planet.net/>) using an equal area projection (Behrmann). Unprotected KBAs were defined for the purposes of this exercise as those with <50% of their area covered by one or more protected areas, protected KBAs as those having >50% coverage. The mean percentage cover by protected areas of our sample of unprotected KBAs was 7.3%, and 58% had no intersection at all with protected areas. Because some protected area boundaries are missing or wrongly located in the WDPA (www.wcmc.io/WDPA_Manual), in-country partners were asked to review the protected area status of each KBA in their country and remove those that were >50% covered by protected areas according to local knowledge (see below).

We refer to sites that appeared from the survey results to meet some or all OECM criteria as “potential OECMs,” following the definition of IUCN-WCPA (2018a): “A geographically defined space that has been identified as having OECM-like characteristics but which has not yet been assessed against OECM criteria.” No criteria other than the broad definition given above have yet been developed, so assessments of

whether sites qualify as OECMs were necessarily subjective. The use of the qualifier “potential” also recognizes the fact that some areas identified as OECMs may later prove to meet the IUCN definition of protected areas, despite currently lacking legal designation as such.

2.1 | Assessing effectiveness

The effectiveness of potential OECMs was assessed in three ways. First, we compared pressure-state-response scores from in situ monitoring, where available, among three classes of KBA: (1) protected KBAs, (2) unprotected KBAs at least partly covered by potential OECMs, and (3) unprotected KBAs with no coverage by potential OECMs (following definitions of “protected” and “unprotected” KBAs above). These scores are derived using BirdLife’s IBA monitoring protocol (BirdLife International, 2006); recent (post-2010) estimates were available for around 20% of the KBAs in the ten selected countries. The scores are ordinal; pressure scores indicate the degree of pressure the site faces from the threats identified and range from low (0) to very high (–3); state scores indicate the condition of the site and range from very unfavorable (0) to favorable (3); response scores relate to the level of conservation action at the site and range from negligible (0) to high (3) (BirdLife International, 2006). These scores have been found to be highly reproducible across users and to correlate well with remotely measured environmental changes (Buchanan, Fishpool, Evans, & Butchart, 2013; Mwangi et al., 2010). Because the scores are ordinal, and because scores within countries may not be independent, we fitted cumulative link mixed models of each index using the “clmm” command in the R package “ordinal,” with KBA class (three levels) fitted as a factor and country as a random effect. Because the three classes of KBA were found to differ systematically in slope and human population density (see Results)—factors that along with altitude have previously been shown to affect threats such as loss of forest and expansion of agriculture (e.g., Beresford et al., 2017)—we also fitted altitude, slope and human population density to these models as covariates. An alternative approach using propensity matching was not possible because we had too few unprotected KBAs without OECMs. Altitude and slope were extracted and averaged across each KBA from 300-m resolution Shuttle Radar Topography Mission (SRTM) data (USGS, 2006) and averaged to 1-km resolution. Using Global Rural-Urban Mapping Project (GRUMP) data for 2015 (Center for International Earth Science Information Network [CIESIN], 2017), we averaged gridded human population density over each KBA across all 1-km² cells falling at least partly within the KBA.

We then compared rates of forest loss between 2000 and 2012 across the same three classes of KBA in the subset of KBAs identified for their importance to forest-dependent birds (thus linking environmental change directly to the taxa

for which sites were identified). Estimates of total forest loss between 2000 and 2012 were extracted for each KBA from data in Tracewski et al. (2016), based on tree cover loss data from Hansen et al. (2013). The proportion of forest loss during this period was modeled using generalized linear mixed models (GLMM), and the sample was limited to KBAs containing at least 10 km² of forest in 2000 so as to reduce extreme values of proportional loss. Country was fitted as a random effect, and altitude, slope, and human population density as covariates. All competing models were compared using the Akaike Information Criterion (AICc) with the “dredge” command of the R package “MuMIn,” and the R^2 of the best supported model assessed using the “R.squaredGLMM” command (Nakagawa & Schielzeth, 2013).

Finally, surveyors were asked to use their local knowledge of the site and its context to assess whether unprotected KBAs lacking OECMs would be better conserved by an OECM or as a protected area as defined by IUCN.

3 | RESULTS

Of the total of 2,207 KBAs in the ten focal countries, 735 (33.3%) were estimated by spatial intersection to have over 50% of their area covered by protected areas and so were excluded. Expert in-country assessment led to a further 68 KBAs (3.1%) being redefined as protected (see Methods); these were therefore also excluded. Of the remaining 1,404 unprotected KBAs, data were submitted for 740 (52.7%) (Table 1; responses given in Table S2). Missing KBAs resulted from the survey being undertaken only in part of the country in question (e.g., several Provinces in the case of Canada, several islands in the case of Indonesia) or due to uncertainty or unfamiliarity with the site.

3.1 | Prevalence and characteristics of potential OECMs

Of the 740 unprotected KBAs for which data were provided, one or more potential OECMs were present in 566 (76.5%; Table 1). Data were provided on a total of 616 potential OECMs (a mean of 1.09 potential OECMs per KBA with at least one OECM).

GLMMs did not detect systematic differences in altitude among the three classes of KBA ($p > .2$), but slopes were significantly steeper in protected KBAs than in unprotected KBAs (with or without potential OECMs; *post hoc* Tukey's tests, $p < .001$ in both cases), and unprotected KBAs with potential OECMs had significantly higher human population densities than protected KBAs ($p < .0001$) (Figure 1).

The potential OECMs identified in our sample of KBAs spanned a wide range of management and governance types (Figure 2). The highest proportion of potential OECMs were

managed by government, followed by local communities or indigenous groups, and private landowners. Perhaps reflecting the focus of this study on KBAs, 72.7% of potential OECMs had nature conservation as a stated management aim, and the majority of potential OECMs had as their primary management objective the conservation of biodiversity and other natural resources (Figures 2b,c). Funding to support potential OECMs was provided mainly by government, reflecting the dominance of governments as OECM managers in the sample of countries studied. Of the 608 potential OECMs for which responses were provided, only 53 (8.7%) were expected to become less effective or to cease to exist altogether if the site were to become a protected area, whereas 226 (43.2%) were predicted to be equally effective and 297 (48.8%) more effective with the addition of protected area designation.

3.2 | Effectiveness of OECMs

Cumulative link mixed models, with country fitted as a random effect, indicated that pressure scores were unrelated to human population density, altitude, or slope, and the three-level KBA class factor was not included in any of the competing models. The null model, with only a random effect of country, had a Δ AICc value > 10.0 units below that of any of the models with covariates. The best supported model of state was that including human population density and a three-level KBA class factor. Post hoc tests indicated that protected KBAs had a significantly greater probability ($p < .001$) of having higher values of state than did unprotected KBAs with or without potential OECMs (these two did not differ; $p = .4$). The best supported model of response was that including only a three-level KBA class factor and indicated that protected KBAs had a significantly greater probability ($p < .0001$) of having higher values of response than did unprotected KBAs with or without potential OECMs (these two did not differ; $p = .98$); the difference between protected and unprotected KBAs was expected because protected area status itself is scored as a response. In all these analyses, sample sizes were fairly small (< 400 KBAs in total, and sometimes < 40 in the class of unprotected KBAs with no potential OECM), as not all KBAs had recent monitoring assessments.

The model of forest loss from 2000–2012 that received the greatest support was that containing the three-level factor relating to KBA type together with the covariates of slope and human population density. This model received 74.6% of combined model weight and had a Δ AIC value of 3.14 (Table S1b), although the conditional R^2 was low (16.1%). The model indicated that protected areas had significantly lower forest loss than did KBAs outside protected areas, with or without a potential OECM (Figure 1d).

For the 174 unprotected KBAs without OECMs, responses to the question of whether the site would be better conserved

TABLE 1 Summary of KBAs by country included in the analysis and prevalence of potential OECS in unprotected KBAs (defined here as those with < 50% coverage by protected areas)

	Protected KBA	Unprotected KBA, with OECS	Unprotected KBA, no OECS	Unprotected KBA, not assessed	Total KBAs
Australia	198	67 (53.2%)	59 (46.8%)	0	324
Bolivia	31	4 (19.0%)	17 (81.0%)	0	52
Canada	74	41 (80.4%)	10 (19.6%)	198	323
Ecuador	47	66 (89.2%)	8 (10.2%)	2	123
India	152	146 (89.6%)	17 (10.4%)	190	505
Indonesia	112	21 (42.9%)	28 (57.1%)	272	433
Kazakhstan	35	80 (94.1%)	5 (5.9%)	0	120
Kenya	36	51 (81.0%)	12 (19.0%)	1	100
Philippines	52	74 (98.7%)	1 (1.3%)	0	127
South Africa	63	16 (48.5%)	17 (51.5%)	4	100
Total	800	566 (76.5%)	174 (23.5%)	667	2,207

Note: Numbers in parentheses indicate the percentage of unprotected KBAs that were assessed as having an OECS or no OECS.

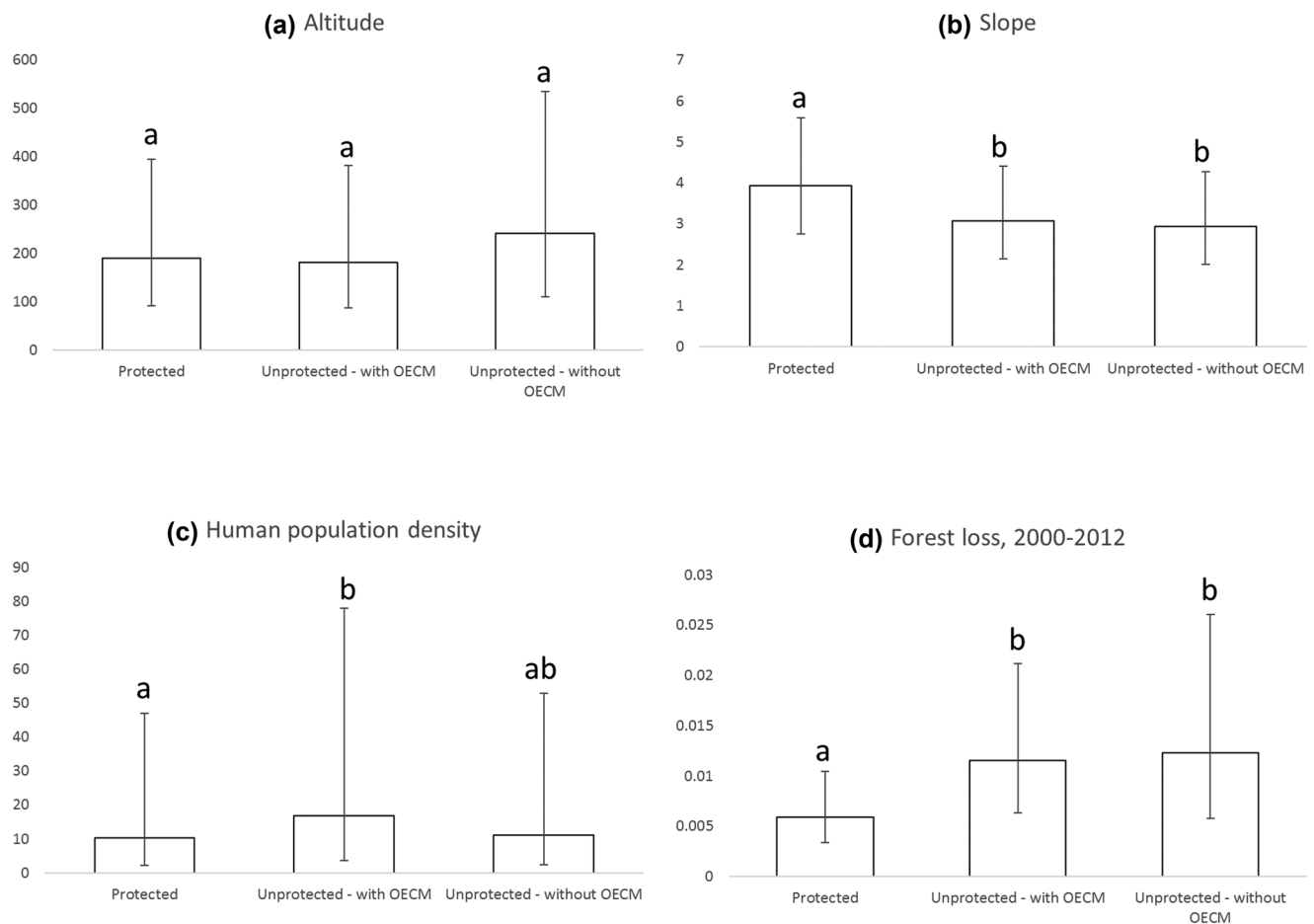


FIGURE 1 (a)–(c) Mean ($\pm 95\%$ CL) of altitude (m), slope ($^{\circ}$) and human population density (people per km²) in protected KBAs and KBAs with and without potential OECS. The values shown are back-transformations of estimates from GLMMs of the logged values, in which country was fitted as a random effect. (d) Mean ($\pm 95\%$ CL) of proportion of forest lost, 2000–2016, showing back-transformations of estimates from a GLMM of the logged values, in which country was fitted as a random effect and slope and human population density as covariates; see text. Bars sharing letters do not differ at $p < .05$. Sample sizes differed between analyses because not all covariates were available for all sites; sample sizes for graphs a, b, and c were 1,427, 1,487, and 1,455 respectively. In graph d the sample was restricted to KBAs identified for forest-dependent birds ($n = 676$)

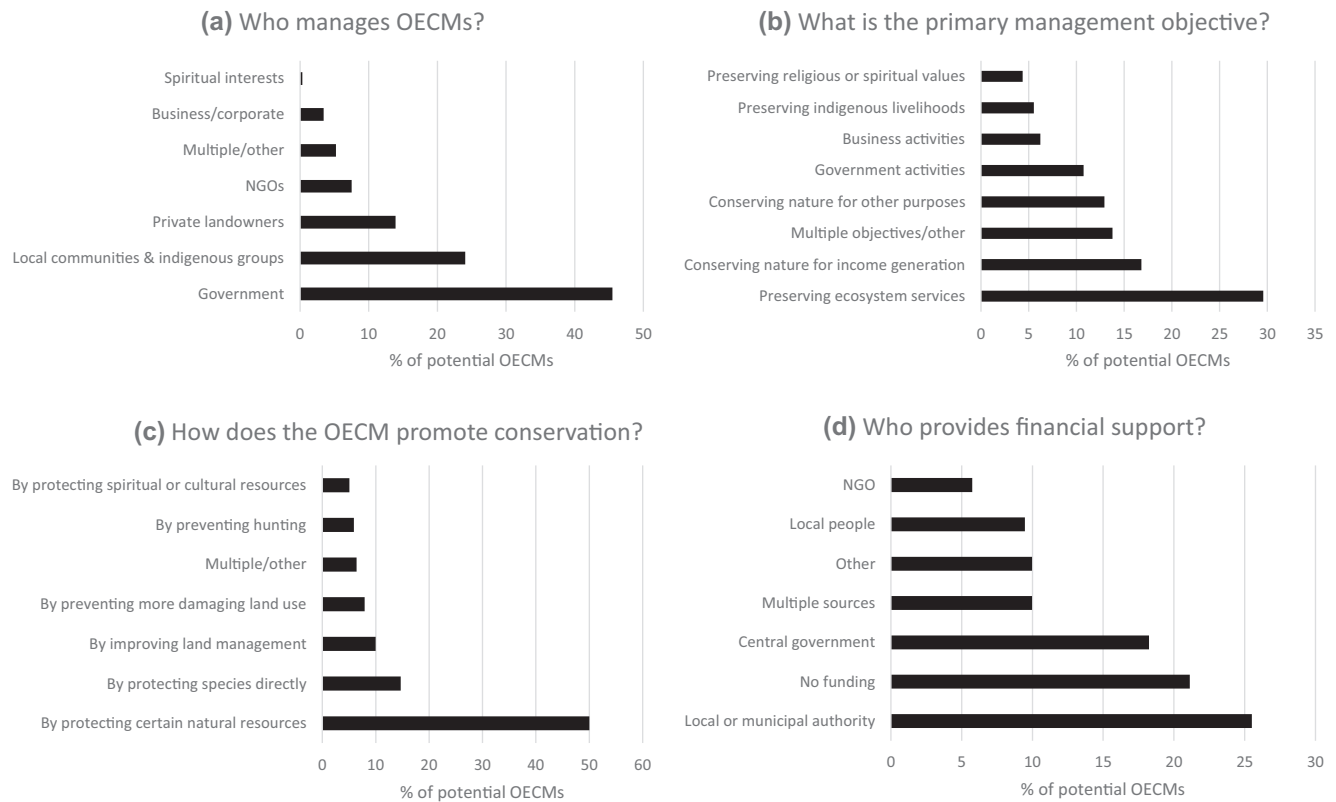


FIGURE 2 Survey responses to questions on the management and funding of OECMs

as an OECM or as a protected area were received for 150 (87.0%). Of these, 84 (56.0%) KBAs were thought likely to be more effectively conserved as an OECM and 56 (37.3%) as a protected area, with a small number of responses indicating the need for neither or for other forms of management.

4 | DISCUSSION

We present the first assessment of the prevalence, characteristics and effectiveness of OECMs in a large sample of sites of conservation importance. Our results suggest that management and governance systems meeting the characteristics of potential OECMs are prevalent in KBAs. Even if some apparently unprotected KBAs actually meet the definition of protected areas, our conclusion that a high proportion of unprotected KBAs contain potential OECMs is unaffected. A high proportion of potential OECMs at KBAs had the conservation of biodiversity or other natural resources as the primary, or as a stated, management objective. This may mean that, in some cases, these potential OECMs would better align with the IUCN definition of a protected area despite the absence of a legal designation. This reinforces the common understanding that many measures without a formal designation may still meet the IUCN definition of a protected area, raising challenges to the identification of OECMs and suggesting that consensus or guidance is required to ensure that important

sites for biodiversity are correctly identified as protected areas or OECMs. It is clear that the newly adopted OECM definition presents an opportunity for governments to review national approaches to recognizing and documenting conservation measures. Such reviews could clarify which measures should be considered OECMs and which protected areas, and identify appropriate avenues of recognition and support with the participation and consent of stakeholders and rightsholders.

Models of pressure-state-response indicators found no systematic difference in scores of state or conservation response between KBAs with and without potential OECMs, and that both were lower than equivalent scores from protected KBAs. As the conservation response score explicitly captures protected area status as a response, this result was expected. Furthermore, there was no significant difference in modeled rates of forest loss between 2000 and 2012 between KBAs with and without potential OECMs, and both had significantly higher rates of forest loss than did protected KBAs. Nevertheless, respondents suggested that conservation of KBAs lacking both protected area status and an existing potential OECM would usually be better achieved through an OECM than a protected area. This may in part reflect our finding that unprotected KBAs, both with and without OECMs, occur in areas of significantly higher human population density and on flatter land, where pressure on natural resources may be higher and the creation of protected areas less politically palatable or more time-consuming. A tendency for protected areas to

be overrepresented in remote, steep areas has previously been identified (Joppa & Pfaff, 2009). The fact that so many sites of recognized conservation importance survive outside protected areas in areas of high human population density suggest a degree of effectiveness of OECMs.

This is the first study to assess the prevalence of potential OECMs in areas of particular importance for biodiversity. It is not clear whether the prevalence and characteristics of potential OECMs outside KBAs are likely to differ from those found within KBAs, and hence how representative our sample is of OECMs more generally. For example, the relative rarity of systems aimed at preserving indigenous livelihoods and cultural or spiritual interest in the sample of potential OECMs identified by this project may simply reflect the restriction of our study to KBAs.

Given the high degree of overlap between OECMs and KBAs, we recommend that data on the coverage and characteristics of OECMs overlapping KBAs are added to the WDKBA, and are required as part of the documentation of newly proposed KBAs. Over the coming years, this information will be increasingly available for uptake into the WDKBA from the World Database on Protected Areas or a parallel database. Our analysis reaffirms the importance of tracking the effectiveness of different forms of governance and management at important sites for biodiversity, including both remote sensing and in situ monitoring (Buchanan et al., 2013). Finally, our results have implications for negotiations through the CBD on the post-2020 strategic plan on biodiversity. Almost half of the potential OECMs identified by this project are government-managed, indicating that the future of OECMs lies largely in the hands of those negotiating and agreeing the post-2020 CBD agenda. Future targets for area-based conservation need to continue to address the role of measures that supplement the formal designation of protected areas, and recognize that they represent an opportunity to support the delivery of biodiversity conservation outcomes.

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SUPPORTING INFORMATION

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

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