

Building towards the marine conservation end-game: consolidating the role of MPAs in a future ocean

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ABSTRACT

1. Progress on spatial conservation efforts in marine environments is often summarized with the simplistic metric of extent. However, targets require a more nuanced view, where ecological effectiveness, biodiversity, representation, connectivity and ecosystem services must all be recognized. Furthermore, these targets must be achieved through equitable processes and produce equitable outcomes.

2. This paper calls for a clearer definition of what is to be ‘counted’ in assessing progress in marine conservation, through the use of both traditionally defined marine protected areas and a limited subset of other equivalent areas. It calls for future effort to draw a clear distinction between non-extractive areas such as no-take marine reserves, and the more numerous extractive areas. To be considered protected, sites must be ecologically effective, and be equitably managed to support all stakeholders.

3. Spatial extent of coverage is only one constituent part of conservation effort, however, and much greater effort is needed to ensure that sites are selected to achieve optimum conservation outcomes for biodiversity and for ecosystem services. The paper reviews some of the existing views and approaches to defining and delimiting marine protection priorities.

4. It recommends that with a clearer set of metrics for defining protection, and for assessing progress and setting future targets, marine conservation will be better placed to achieve lasting outcomes, including halting biodiversity loss and securing or enhancing ecosystem service provision. Protected spaces will continue to play a major role in future oceans, but they also need to be configured within a wider spatial framework.

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INTRODUCTION

In a planet rapidly growing to 10 billion people, with rising levels of unsustainable consumption, there are growing demands on our marine and coastal space. Human uses of the ocean are growing and diversifying, with aquaculture, seabed mining, renewable energy developments, land-claim and coastal engineering burgeoning in spaces already crowded with shipping, oil and gas extraction, tourism and fisheries. As a result, the need for effective marine conservation, integrated into a more holistic ocean management regime, has never been greater.

Marine conservation is critical to any sustainable development effort and establishing marine protected areas (MPAs) in particular has received considerable attention. In 2014 there were some 12 000 recorded MPAs (Juffe-Bignoli *et al.*, 2014). Since then the addition of a number of other very large MPAs combined with recent pledges for additional areas suggests that a total of 16 million km² of the oceans will soon fall within MPAs, covering some 4.4% of the world's ocean, including 11% of jurisdictional waters (Spalding and Hale, 2016). Of course such numbers include a very mixed array of sites, from areas that were established in an *ad hoc* fashion to areas created through systematic marine planning exercises to protect specific ecological values, and from vast strictly protected areas through to sites with highly limited management intentions and even fewer management outcomes. They also exclude sites that may be achieving critically important conservation functions without the formal moniker of an MPA.

These same percentage coverage statistics clearly fall short of the target of 10% coverage agreed under Aichi Target 11 and confirmed by the sustainable development goals (SDGs) (UN General Assembly, 2015). More importantly, however, such numbers give no indication of: the stated objectives or design features; the coverage of biodiversity or provision of ecosystem services; the level to which sites are being effectively or equitably managed; or indeed of the efficacy of such sites in achieving conservation outcomes. These international targets stress that such

elements need to be considered, but in the rush to reach targets for spatial coverage, it appears that corners may be being cut, and effective conservation outcomes overlooked.

Current efforts at MPA designation can appear piecemeal and opportunistic (Agardy *et al.*, 2011; Devillers *et al.*, 2015). While considerable effort has gone into prioritizing MPA designation for biodiversity, and in understanding and defining many elements of effectiveness, the application of such tools and approaches remains far from complete. Meanwhile in other areas, such as equitability and delivering ecosystem services, the debate on approach and prioritization has barely begun. A further concern is that both Target 11 and the SDGs have only a relatively short-term target, for MPA designation by 2020.

A longer-term vision is needed to ensure that marine conservation is more effective and holistically integrated into ocean use and planning. The end-game for marine conservation must be one in which the entire future ocean is sustainably managed, with nature broadly conserved, both for its biodiversity value and to secure its many benefits to humanity in perpetuity. While continuing to focus on the role of MPAs in achieving such an end-game, this paper highlights four broad areas in need of attention and open debate:

1. The definition of what is being counted needs to be clarified. There is a need to ensure that all areas that are achieving conservation benefits over the long term can be included. There is also a need to differentiate the relative benefits of those sites that offer strict levels of protection from the mixed array of sites that predominate.
2. Deeper engagement in issues of effectiveness and equity are needed, to ensure that MPAs produce outcomes for nature and people, that these are secure over the long term and fairly distributed, and that they are established via fair processes and broadly supported by relevant stakeholders. These considerations are not voluntary additions to the internationally agreed targets, they are central tenets.
3. Further refinement of prioritization is required to ensure, in particular, that 'importance' is recognized and targeted in ongoing protection and planning. In particular there is a need for a clearer

focus on areas of importance for ecosystem service delivery. Spatial targets will only be useful if they are constrained by a focus on important areas.

4. MPAs will only work as part of a broader strategy. While they are a critical tool, MPAs are insufficient on their own. Ultimately the vision for the ocean is for sustainable management of 100% of the ocean space, and other tools must be engaged to achieve conservation benefits, alongside, and fully integrated with, MPAs.

DEFINING AND REFINING 'CONSERVED'

Definitions

The most widely accepted definition of a protected area, developed by IUCN¹, is broadly encompassing, but includes a number of principles for its application: nature conservation must be a primary objective; sites must be secure for the long term; and the target of 'nature' suggests a focus beyond single species protection (Dudley, 2008).

Aichi Target 11 added further complexity by recognizing that formal 'protected areas' are not the only places where spatially focused conservation takes place. It broadened the target to include 'other effective area-based measures' (OEAMs) as possible spatial tools for conservation (CBD, 2010). This addition was meant to enable the inclusion of sites that are often not accounted for in the national databases, such as traditionally owned and managed areas, fisheries reserves or other settings where restricted uses are compatible with conservation objectives.

A critical look at these components of the definition leads to a number of concerns.

First, confusion exists even with the interpretation of the basic IUCN definition. For example, it has been suggested that as much as 40% of US jurisdictional waters could be included

as 'protected', or as little as 3.1% (Spalding *et al.*, 2016). Elsewhere, one IUCN publication suggested that 'the entire CCAMLR area is considered to be category IV' (Day *et al.*, 2012). This existing site is considerably more than double the size of all currently existing and pledged MPAs.

Second, there are concerns around the broad scope of protection. MPAs range from strict marine reserves to sites where quite intensive human use is an integral component. While IUCN encourages the recognition of a series of management categories (Day *et al.*, 2012), their current application adds little clarity. In a quick assessment of 380 sites known to be fully no-take, it was found that they fell across the entire spectrum of management categories – only 30% were in the stricter IUCN Categories I–III, 45% were in the less strict management categories IV–VI, while the remaining 25% were not reported by management category².

Finally, the Aichi recognition that OEAMs could achieve the same benefits as MPAs, runs the risk that the very framework for understanding and measuring spatial conservation efforts could be undermined. In one scenario, the distinction between MPAs and OEAMs may be immaterial and the outcomes indistinguishable. Alternatively the OEAMs run the risk of becoming a let-out clause, insufficiently defined to drive real conservation, but useful for parties seeking to claim success.

Expanding the definition

MPAs are not the only places where spatially focused marine conservation takes place. Long-term and effective protection may occur in traditionally owned and managed waters and in other settings where restricted uses are compatible with conservation objectives. By way of example, these include:

¹'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). IUCN has generally taken 'marine' as including 'any area of intertidal or subtidal terrain' (Kelleher, 1999), while CBD uses the term marine and coastal protected areas and includes 'any defined area within or adjacent to the marine environment...' (CBD, 2002)

²Protected areas were annotated as fully or partially no-take with data from the database, enhanced with additional data from the Zoological Society of London. It is worth noting, more broadly, that some 45% of sites in the WDPA do not have any assigned management category, greatly reducing any potential utility of these categories in understanding global distribution by management approach.

- Conservation-congruent regulations, where spatially explicit management achieves nature conservation as a secondary benefit, such as certain areas closed for military use; buffer areas around wind farms; or places with managed fishery regimes that focus on multiple species and/or multiple impacts.
- Indigenous and community conserved areas, where conservation benefits are achieved and maintained long term through customary laws or other effective means.
- Generic natural resource protection, which is sometimes applied to entire ecosystems in a jurisdiction, such as prohibiting the cutting or clearance of mangroves (e.g. Sri Lanka, Tanzania). This may not include specific protection of areas, but achieves the same effect.
- Mosaic protection, where a combination of independent measures overlap to achieve conservation benefit. This might include overlapping fishery controls, including seasonal controls or access regulations, or other combinations including controls on shipping traffic, seabed mining or land-based sources of pollution.

It was in recognition of such places that Aichi Target 11 included OEAMs as possible spatial tools for conservation alongside protected areas (CBD, 2010). Such areas are important, but tightly defined criteria for inclusion are urgently needed in order to avoid the opening of a Pandora's Box of claims that almost any management intervention should be 'counted'. As with MPAs, ecological outcomes must lie at the heart of any inclusion: sites must safeguard or enhance nature and natural services, to a degree that would not happen without such interventions.

While the potential of such areas is very important, there is a considerable risk that running a parallel system for MPAs and OEAMs will cause confusion and weaken efforts to prioritize and designate conservation areas, and to assess and track progress. It would be far clearer if the two systems could be united by refining the definition of an MPA, to ensure a focus on ecological outcomes. Key components of this definition would include the management of a clearly defined spatial location in a manner that secures and delivers conservation benefits over the long term.

Such an inclusive approach would lead to an increase in the apparent coverage of MPAs worldwide, but it would also enable accounting to fall in line with the current international targets. It would further give a more accurate portrayal of conservation effort and achievement, one that looked beyond the bounds of specific environmental ministries or the views of biodiversity-focused conservation organizations. There remains the very real problem that MPAs would continue to cover a broad spectrum, with a highly variable array of benefits (Locke and Dearden, 2005). To begin to understand this there is a need to look beyond the simple binary of protected versus unprotected sites, and to develop an improved and clearer categorization of MPAs which enables the identification of their distinct ecological benefits.

Categorizing protection

MPAs already include a medley of management approaches and conservation outcomes and there is a clear need to develop better metrics for describing the level of protection provided by different sites. In fact the range of ecosystems, human impacts, management approaches, ecological benefits and social outcomes expected from MPAs is so vast that any detailed categorization would be extremely challenging. IUCN has developed and encouraged the use of 'management categories' to help to distinguish different levels of management intent (Day *et al.*, 2012), but their current application adds very little clarity. However, considerable clarification could be obtained by a high level distinction between extractive and non-extractive areas.

Non-extractive MPAs

Non-extractive MPAs should be defined as sites where no extraction (or destruction) of any living or non-living resources is permitted. These include most no-take areas and strict marine reserves. Within the general restriction of this definition, a small degree of flexibility should be allowed for closely monitored activities relating to scientific research, very low-level sustenance or non-consumptive

tourism activities provided these have no measureable long-term ecological impacts.

Broadly these sites can be equated to the IUCN Management Categories I–III, and while it may prove impossible to implement further categorization at the global level, there could nevertheless be some value in subdividing these where possible, broadly following Day *et al.* (2012), into:

1. large areas, with limited human access even for non-extractive activities (IUCN Category Ib);
2. large areas where human access and non-extractive activities may be more widespread (Category II);
3. small areas which are of focused ecological importance, such as ecological reserves and Sites of Special Scientific Interest (SSSIs). These may include sites for rare species conservation but also fisheries replenishment areas, spawning and other aggregations, and other areas which serve wider ecosystem service generation (Categories Ia and III).

Extractive MPAs

The vast majority of MPAs allow some level of human activities which have a tangible impact on species or ecosystems. In large part this is focused around extractive activities (primarily fishing, but in some cases removal of non-living resources), but many sites also allow some impacts from activities such as boat traffic and anchoring, waste disposal, localized dredging for boat access, tourism, aquaculture, or sustainable energy generation. Human influences also come from efforts to alleviate environmental damage including removal of invasive species, restocking and habitat restoration.

The IUCN management categories make a useful distinction between sites dominated by positive interventions such as restoration (Category IV) and others where human use and extractive activities such as fishing or oyster farming may be part of the ‘seascape’ (Category V), but of course many sites may contain elements of both. More broadly it would clearly be useful to distinguish types of permitted activity and the relative impact of different activities as there are currently no clear clusters or groupings of management regimes on these lines. It may be most practical to develop

separate classifications for different activities and apply these independently to each site.

In moving beyond the basic definition, and some level of categorization, there is a need to consider the selection and management of sites. Sites must work in reality, and to achieve this they must be effective, equitable, and embedded in a wider management framework.

EFFECTIVENESS AND EQUITY IN DESIGNATION AND MANAGEMENT

Effectiveness

The IUCN definition of a protected area (Dudley, 2008), and Aichi Target 11 both stress that sites must be effective: they must make a difference on the ground. In reality, inclusion in protected areas inventories and assessments has almost entirely been based on *intended* outcomes of designations: many sites are included that are not being managed effectively or achieving a conservation purpose and should, under both the definition and the criteria of the international targets, be excluded from metrics of progress.

There are two broad reasons why sites may fail to be effective: inadequacy of design and failure of implementation. While the latter has received considerable attention, poor design is often overlooked.

Inadequacy of design. Many sites fail because their boundaries or regulations are inadequate to meet their objectives. Sites may be too small to contain viable populations of threatened species; or may exclude key life-history processes such as spawning aggregations or nursery grounds. *Ex situ* influences such as pollution or sedimentation may be so extreme outside the protected area that they overwhelm any relief that protection might provide. Alongside such ecological considerations are a host of social and economic reasons why sites may fail, even at the design phase, and some of these are explored in the following section on equity. In fact the components of good design are complex and likely to be highly specific to ecosystems, locations and conditions, including a socio-economic context. Small sites may still succeed if developed in a broader network or supported by wider spatial planning initiatives. Structured benthic habitats can host self-sustaining populations within spaces as small as a few

square kilometres, but in open pelagic systems, even millions of square kilometres are insufficient to contain the entire life history of single individuals.

Failure of implementation. 'Paper parks' are sites that are so poorly resourced or managed that they make little or no contribution to conservation. Local people may even be unaware of their existence and threatening activities continue almost unabated. Such failure can often be due to challenges with sustainable financing, lack of adequate capacity, or ineffective actions being taken to manage human activities in the area, however, even well-resourced parks may be ineffective when they are not integrated with adequate management frameworks outside of the boundary of the protected area.

Too much attention is often given to the expansion of protected areas coverage, to the detriment of management effectiveness. In part driven by targets, many donors, agencies and NGOs have developed new projects to support new MPAs, but far less has been done to increase the capacity of management agencies or to ensure sustainable financing. In the south and east Mediterranean, for example, some MPA agencies have pointed to the fact that creating new areas often comes at the expense of the progress achieved with previous areas, due to limited budgets and personnel (Meliane *et al.*, 2015).

In terms of conservation it is critical that effectiveness is defined by outcome – i.e. the stabilization or indeed enhancement of natural ecosystems and ecosystem services. The IUCN Green List is greatly strengthening the dialogue and approaches in this regard, developing a standardized and independent review procedure which still recognizes the very diverse settings for protected areas outcomes (IUCN, 2016). The challenge of applying such a scheme to 12 000 MPAs worldwide is immense, but even by focusing attention through a smaller subset of MPAs it may be possible to influence effectiveness of sites more broadly.

Equity

Equity is another key and often neglected component of Aichi Target 11 and other marine conservation targets. Indeed the call for sites to be 'equitably managed', carries with it the challenging questions

of whether sites which do not achieve minimal equity standards should be excluded from assessments of conservation progress and what might those minimal standards be? Equity considerations can be summarized under two broad elements:

Inequity in governance processes. Lack of incorporation of local and indigenous communities, traditional resource users and other stakeholders into the planning, implementation and ongoing management of protected areas has long been identified as an issue of concern for protected area managers as evidenced by the Proceedings of the 1982 World Parks Congress (McNeely and Miller, 1984) This failure has often stemmed from a lack of recognition of the traditional rights, tenures, cultures, knowledge systems or traditional resource management and governance systems of local communities (Borrini-Feyerabend *et al.*, 2004). Not surprisingly this can lead to negative sentiments towards conservation initiatives or managers, or to questions about the legitimacy or cultural appropriateness of an initiative (Bennett, 2016).

Inequity in socio-economic outcomes. Many conservation initiatives have produced negative social consequences for local communities, including displacement, lost livelihood opportunities, increased poverty, and exclusion from management (Bennett and Dearden, 2014b). Although protected area planners are now much more aware of these impacts and the need to mitigate them (Dearden *et al.*, 2005), there is still considerable concern and resistance to MPAs in many parts of the world.

Equitable MPA processes and outcomes are important for two broad reasons. First, because they are ethical: they constitute the right way to do conservation (Chan and Satterfield, 2013) and second, because they are instrumental to developing support for conservation (Charles and Wilson, 2009; Bennett, 2016). Such support may be a critical guarantor of the success of any conservation intervention over time, but may also encourage the uptake of MPAs and replication of good practice in other settings.

Unfortunately insufficient attention has been given to describing what is meant by equitably managed in the Aichi Target 11, leaving many conservation organizations and national governments unclear about its importance or

about practical steps required to achieve equity in conservation settings.

Defining and implementing equity

Marine conservation has the potential to contribute to many socio-economic benefits, but specific actions need to be taken so that exclusion and negative social consequences are avoided.

There are three main components to equity: procedural, recognitional, and distributional (McDermott *et al.*, 2013; Pascual *et al.*, 2014). Procedural equity refers to the equality, inclusiveness or balance of participation in the decision-making process. Recognitional equity recognizes the need to account for diverse cultures and associated values, pre-existing rights and tenure, and traditional management and governance structures. Distributional equity relates to the fair distribution of the costs and benefits of conservation to different groups – across space (e.g. to groups living near and far from the area) and time (e.g. to present and future generations). All three components of equity are critical in the governance, design and management of MPAs.

Equitable governance. Governance processes should start with recognition and engagement of all stakeholder groups and incorporation of differing values, cultures and knowledge. There needs to be recognition of pre-existing tenure, governance and decision-making processes. In establishing new conservation management regimes, equity also needs to be built into governance – including laws, policies, management structures and ongoing stakeholder engagement processes (Smith, 2012).

Equitable design. Many MPAs are still selected based solely on ecological and biological criteria, with socio-economic considerations incorporated after the area has been identified. Yet, there have been significant advances in thinking about how to incorporate social, cultural and economic considerations into the design of MPAs (Kittinger *et al.*, 2014; Poe *et al.*, 2014). This can also include economic equity analyses (Halpern *et al.*, 2013), bio-economic modelling of the distribution of impacts (Charles, 2010), and proactive social impact evaluations (Esteves *et al.*, 2012).

Equitable management. To optimize socio-economic benefits for local communities, MPA management can include programmes to support alternative livelihoods

(Cattermoul *et al.*, 2008) or implement benefit sharing agreements (Wynberg and Hauck, 2014). Compensation packages can be considered to address lost benefits. After implementation, programmes of social and economic impact monitoring can be used to track the distribution of costs and benefits and social impacts (Franks *et al.*, 2014), and can be used to inform adaptive management.

Equity, in both process and outcomes, needs to be examined according to objective measures (such as levels of stakeholder involvement, wealth, assets) as well as the perceptions of locals on whether an initiative is believed to be equitable (Bennett, 2016). The equitability of governance processes can be monitored through examining indicators for fairness, participation and inclusiveness (Bennett and Dearden, 2014a).

There may also be a need to establish clear decision rules to determine any conservation actions that might be deemed unacceptable on the basis of equity (Bennett *et al.*, 2015). For example, in some cases, MPAs might be politically unacceptable, culturally inappropriate or socially or economically unworkable. In these cases, rather than producing paper parks or generating active opposition, other types of natural resource or fisheries management might ultimately prove more effective.

As with effectiveness, equity is not a binary metric and MPAs range considerably in the degree of equity applied in both their implementation and in their ongoing management. In future the assessment of equity in individual MPAs would be greatly helped by the development of simple metrics for quantifying equitability, or indeed guidelines on how to account for sites which might be considered inequitable.

PRIORITIZATION

The conservation of 'areas of particular importance for biodiversity and ecosystem services' is central to Aichi Target 11. In reality, considerable attention has been paid to biodiversity, while the prioritization of ecosystem services has largely been ignored.

Biodiversity prioritization

Biodiversity conservation has been a powerful justification for promoting, selecting or justifying the designation of MPAs around the world. A variety of metrics have been developed for the assessment of biodiversity coverage, including the mapping of taxonomic patterns and coverage (Butchart *et al.*, 2015; Klein *et al.*, 2015); the development of biogeographic regionalizations as a framework for representativeness (Spalding *et al.*, 2007; UNESCO, 2009; Last *et al.*, 2010; Clark *et al.*, 2011); and assessments of habitat coverage (Pittman *et al.*, 2011). Further studies have encouraged the use of weightings to support prioritization based on highest species counts (Roberts *et al.*, 2002), areas of endemism (Allen, 2008), or threat (Ricketts *et al.*, 2005).

These different approaches, however, are not always aligned (Orme *et al.*, 2005). Given the wide array of possible prioritization approaches there is also an argument for an approach which places a human filter over the science. At the international level this has been attempted by the CBD-endorsed ecologically or biologically significant areas (EBSAs) process, where sites are prioritized through a process of expert review informed by a range of criteria including uniqueness, vulnerability, diversity, productivity, and naturalness (CBD, 2008).

Ecosystem service prioritization

There have been few efforts to identify areas important for ecosystem services, mostly focused on small spatial scales (Guerry *et al.*, 2012; Grantham *et al.*, 2013; Arkema *et al.*, 2015). Indeed the global mapping of ecosystem services remains largely in its infancy (Hutchison *et al.*, 2013, 2015; Spalding *et al.*, 2016).

Ecosystem services are broadly defined as the benefits that natural ecosystems provide to people (Millennium Ecosystem Assessment, 2005). They can be classified in many different ways (Fisher *et al.*, 2009; Nahlik *et al.*, 2012), but in practical terms it is important to develop a simple framework based on a parsimonious combination of the literature, and with practical utility. A focus on 'final ecosystem services' (Potts *et al.*, 2014) should be encouraged, notably around six broad classes:

- A. Food provision – fish, shellfish, seaweed
- B. Other biological products – mangrove timber, fertilizer, pharmaceuticals, cosmetics
- C. Climate regulation – carbon storage and sequestration
- D. Coastal protection – wave attenuation, erosion prevention, sediment retention
- E. Waste breakdown/removal – de-nitrification, toxin removal, oxygenation
- F. Cultural enhancement – tourism and recreation, aesthetic, spiritual, health and well-being benefits (Galparsoro *et al.*, 2014; Potts *et al.*, 2014).

As with biodiversity, there continues to be an ongoing debate around how to count ecosystem services. The encouragement of efforts to develop models and maps to understand the spatial distribution of value, and the underpinning social, economic and ecological drivers of value must be actively encouraged. Further debate would also be welcome on the relative importance of MPAs in conserving or enhancing different services – the closing of a mangrove to timber harvest cuts off one ecosystem service while enhancing others (carbon sequestration, fish and shellfish provisioning, tourism and recreation opportunities); similarly, while non-extractive MPAs may offer considerable benefits to diving-related tourism (Sala *et al.*, 2013), their role in fisheries is complex and greatly influenced by the location and size of individual sites (Charles, 2010).

There is an urgent need to develop a process for the identification and prioritization of areas of importance for ecosystem services. While there are challenges as discussed, they should not stop action. There is already a sufficient knowledge-base to support an evolving review process. This could parallel the process for identification of EBSAs.

At regional to global scales there would be considerable value in defining, mapping and prioritizing large-scale Areas of Critical Importance for Ecosystem Services (ACIES) from an expert review of available knowledge. Such areas should include:

1. areas providing maximum benefits to people (many people and or high value), with value interpretable as economic or non-monetary metrics, including jobs, food security or cultural and aesthetic values;

2. areas with high potential values (through improved management or restoration).

Within these there may be further merit in identifying:

3. areas of absolute highest value for individual ecosystem services (e.g. the most important blue carbon stores);
4. areas where multiple services and or multiple ecosystems provide combined high value.

HOLISTIC OCEAN AND COASTAL MANAGEMENT

MPAs and equivalent areas are highly influenced by their surroundings. They may be degraded by land-based activities, nearby fishing, or the diffusive spread of pollutants. They may depend on new life arriving as larvae from beyond their boundaries, or on nutrients, sediments or the migrations of transient species from further afield, including from other protected areas. Equally, however, MPAs can exert a critical and important positive influence on their surroundings – generating fish for harvest, removing pollutants and supporting the survival or recovery of otherwise unprotected biodiversity.

In designing conservation interventions it is critical to consider this wider spatial setting, and this is recognized in Aichi Target 11, which talks of the need for MPAs to be 'ecologically...well connected' and 'integrated into the wider landscapes and seascapes'. These requirements necessitate a bigger vision, with conservation efforts built across large scales and embedded in a wider management framework. Ultimately this drives us towards the need for whole-ocean management, where 100% of ocean space falls under a thought-out and holistic management regime.

Connected conservation

The ecological understanding of connectivity is well advanced in many areas. Patterns of movement within and between habitats by different species and over different temporal and spatial scales are increasingly well understood (Sheaves *et al.*, 2014;

zu Ermgassen *et al.*, 2015), and such knowledge has been used to recommend design approaches for marine conservation networks (Mumby, 2006; Guidetti *et al.*, 2013; Green *et al.*, 2015), and even to account for future climate change (Brock *et al.*, 2012). Such design components are also being linked to human needs, including fisheries enhancement (Gaines *et al.*, 2010). This knowledge needs to be utilized more broadly in developing protected areas to maximize effectiveness and benefits both to biodiversity and services.

Integrated planning and management

Many of the issues now facing marine biodiversity and ecosystem service provision cannot simply be secured through the declaration of MPAs, particularly where policies and practices in surrounding areas of land and sea may directly conflict with conservation intentions. There is a need for processes to integrate multiple needs and uses, different sectors, stakeholders and management approaches, and for efforts to build conservation and sustainable use into this holistic approach.

Such holistic planning within coastal and ocean waters has been implemented at small scales by local communities in countless settings and many traditional approaches are now being strengthened in the growing processes of devolution, observed in movements such as locally managed marine areas and territorial use-right fisheries (Jupiter *et al.*, 2014; Moreno and Revenga, 2014). While such approaches are clearly a part of the very broad fields of marine spatial planning and integrated coastal zone management, such terms are often focused on larger-scale efforts with a more complex suite of interests and activities (Ehler and Douvère, 2009; White *et al.*, 2012). In all cases, however, the role of community engagement is critical (Charles *et al.*, 2010). Initially slow uptake (Sale *et al.*, 2014) of marine spatial planning now appears to be changing with some 10% of jurisdictional waters currently under some level of marine spatial planning and evidence for accelerating growth (Ehler, 2013 and Charles Ehler, pers. comm. Jan. 2016). This is perhaps not surprising as governments, stakeholders and new interest groups seek to resolve growing demands

for access, new uses and business certainty across multiple sectors. Beyond EEZ areas, considerable governance challenges remain, however, and large-scale management is almost entirely limited to sectoral planning, notably around fisheries (Ban *et al.*, 2014; Rochette *et al.*, 2014).

The conservation community needs to encourage and engage in this growth of marine spatial planning as a means to increase marine conservation, and to ensure that the broader array of uses of ocean space, from fisheries to coastal development to agricultural run-off, are effectively planned and managed so that they do not undermine marine conservation. MPAs must remain a critical component in such planning, but conditions beyond MPAs will also be critical for the sustainable futures for people and biodiversity. There is also a growing need to improve the tracking of MSP efforts and particularly their relevance and contribution to marine conservation. To this end there would be merit in developing spatial databases, designed to be used alongside and in conjunction with protected areas databases such as the World Database on Protected Areas.

DISCUSSION AND CONCLUSIONS

The internationally agreed targets of 10% protection of the oceans by 2020 have played an important role in galvanizing efforts and mobilizing new actors and additional funding for establishing new MPAs all around the world. They are probably best considered as an interim goal, with only a short time-frame remaining, and new, higher, targets will probably be established in the future as was done for terrestrial protected areas.

Even 10% is challenging – in strict spatial terms it would call for more than doubling of existing marine protection in less than 4 years, but the challenge is far greater when the wider elements of the Aichi targets are considered.

The 10% needs to be ‘ecologically representative’. While a detailed meaning for this has not been settled, if it was assumed to mean 10% of each habitat or ecoregion then many of the large gains to single habitats or ecoregions would be superfluous, and far greater protection would be

needed to fill the gaps. Currently more than a quarter of coastal and shelf ecoregions and more than half of pelagic provinces have <1% MPA coverage (Butchart *et al.*, 2015).

The Aichi Target also calls for attention on ‘the most important’ areas. In reality many protected areas are not so targeted, and may in fact be selected on grounds of ease of establishment, political expediency or opportunism (Devillers *et al.*, 2015). Once again it may be questioned whether or how areas of low importance should be counted as making a contribution to national or global targets. The South Orkney Islands Southern Shelf MPA is an important milestone as the first (and thus far only) very large no-take area in the high seas. While important in what it stands for, it was placed in a location where fishing disturbance (the only likely threat currently facing such an MPA) was already minimal. Even then, some countries objected to the original proposal boundary on the grounds that there might be a *possibility* of a viable crab fishery, and so to appease this, a not insignificant area was excluded (Brooks, 2013). Exploratory crab fisheries subsequently invested 80 000 pot hours in 17 sets and caught only three crabs (Brooks, 2013). So the fact that even this ‘celebrated’ MPA had its boundary set in part by an entirely speculative idea for a future fishery underlines the challenge of putting MPAs where they are needed as opposed to where they will be tolerated or undisruptive.

Further thought is also needed as to the appropriateness of 10% as a target. Provided it is seen as both a somewhat arbitrary and an interim challenge, 10% may be useful. Even here, however, it is worth noting that two of the most celebrated and biologically productive marine ecosystems – mangroves and coral reefs – are already among the most protected of all habitats worldwide, with in excess of 30% of their remaining extents falling within MPAs (Spalding and Hale, 2016). Is the job done for them?

Placing such targets within the wider context of a long-term vision would greatly help understanding of their ultimate purpose, for ecosystems and society. Further encouragement for the expansion of MPA coverage will perhaps be incentivized by perceptions of benefits as much as it is mandated

through targets. In this regard, the quantification and communication of ecosystems services generated from conservation efforts will be of considerable importance. As the benefits of marine conservation become more widely understood the need for targets may be replaced by more complex and ultimately sustainable patterns of public or state-driven demand for conservation measures.

Building an integrated vision

MPAs are a powerful conservation tool, but they are costly to develop and manage. As a result it is critical that available social and financial capital is wisely invested in the most important locations. With unprecedented interest in the use of ocean space and resources from many sectors, the urgency for such conservation investment is only growing.

While global and national MPA targets have clearly encouraged growth in declarations, including many very large MPAs, ongoing and future growth needs to be targeted to optimize delivery of biodiversity and ecosystem service benefits through equitable and effective MPA networks. Future marine spatial conservation efforts by countries, organizations and other actors should be guided by the following:

Areas delivering conservation benefits, whether formally declared as MPAs or other sites delivering equivalent benefits, need to be counted together

The allowance, under Aichi Target 11 to include OEAMs is important, but without a clear definition it can open a loophole to include areas that do not provide notable conservation benefits. To avoid the complexities of running two parallel systems, the clearest solution would be to expand the definition of MPAs to include all areas that deliver substantial conservation benefits and are securely managed for the long term.

The clear distinction between extractive and non-extractive MPAs should be accounted for in planning and accounting for marine conservation efforts

The clearest distinction that can be made within the vast range of management approaches in the ocean

is between areas that do not allow any significant extractive activities and those that do. The former, including no-take marine reserves, typically offer very high levels of conservation benefits and should be singled out in planning and designation of MPAs. Extractive MPAs are, however, still important for achieving conservation objectives, particularly in areas where continued human use may be a critical component of both equitable management and ecosystem service provision. What is important is to build a clearer recognition of the different levels of conservation benefits which inevitably arise from different levels of protection.

Further categorization of MPAs requires greater sensitivity to conservation outcomes

Beyond the binary categorization of MPAs into extractive versus non-extractive there is clearly value in developing sub-categories. The current IUCN Management Categories are only of partial use, however, as they give very little indication of ecological outcomes. It may be of greater utility to explore a series of categories focused on the many different activities, impacts, management approaches and ecological sensitivities that can influence ecological outcomes

Spatial targets should be indicative in guiding efforts, but should not distract from conservation objectives or ignore social constraints

The use of percentage targets for MPA coverage has almost certainly encouraged new MPA designation, but sometimes a scramble to increase extent has been undertaken without considering the reasons for protection or for the need to build protection that is both effective and equitable. This tension between positive and negative aspects of spatial targets needs to be acknowledged. Valuable outcomes for the oceans will not be obtained if spatial targets continue to dominate visions, without bringing in a more comprehensive suite of indicators, specific to the realities and requirements for different elements of biodiversity and ecosystem service conservation objectives. Where ecosystems perform a critical function such as coastal protection or fish production, or where an ecosystem is so small or fragile that any

disturbance might lead to its collapse, then 100% protection might be a more appropriate target. Where the spatial extents of species and ecosystems are so vast, or the geopolitical constraints so complex, or the social constraints so great, it may be more appropriate to seek conservation by means other than formal protected areas.

New criteria should be developed for selecting areas of importance for ecosystem services

While the role of many ecosystems in providing services such as food security, jobs and coastal protection is well recognized, the identification of important areas lags far behind equivalent efforts to prioritize areas of importance for biodiversity. This bias may in turn be limiting the ability to recruit the full constituency of partners needed to deliver good ocean management and conservation. The urgent prioritization of Areas of Critical Importance for Ecosystem Services is needed as a means to inform the protection of such benefits, and the quantification and communication of their services and benefits to coastal societies. These could have strong parallels with EBSAs and a combination of scientific syntheses and expert interpretation is recommended as a means to combine the challenging assessment of multiple metrics, synergies and trade-offs, as well as data paucity and the need for a precautionary approach in priority setting.

Key principles and indicators for equity and effectiveness in management of MPAs should be agreed

Critical to the definition of spatial conservation measures is the need for sites to be both effective and equitable. Defining and quantifying effectiveness has received considerable attention, although application of metrics has been more limited (Hocking *et al.*, 2000; Leverington *et al.*, 2010). Future assessments of effectiveness need to focus on outcomes in terms of enhanced conservation benefits, while also seeking to understand which management actions will produce these outcomes. Assessments of equity may be yet more challenging – sites that fail to provide equitable inclusion of stakeholders in the design, operation and ownership of conservation may yet achieve powerful outcomes for conservation, but

they may be compromised in the longer term, or undermine conservation efforts in other places by creating barriers between people and conservation. There is an urgent need for key principles and minimum standards, particularly for assessing and encouraging equity considerations in protection efforts. Monitoring programmes for both effectiveness and equity need to lead to real adaptation of management actions.

Legislation and policies for integrated planning and management should be adopted to advance toward rational and coherent planning and utilization of the ocean and coastal spaces

Successful marine conservation depends on nesting spatial marine conservation efforts within broader management settings. Societies need to consider managing 100% of coastal and ocean space in an integrated process, linking needs for development with needs for the continued delivery of ecosystem service benefits, and for biodiversity conservation. Conservation and development agencies need to encourage such multi-objective marine spatial planning, integrated into a system of coastal management, as a means to avoid conflict and streamline benefit flows. Spatial conservation measures such as MPAs have a central role in such planning, but too narrow a focus on conservation MPAs could lead to lost opportunities for conservation by other means, such as through building sustainability into fisheries and other extractive activities in the oceans everywhere. Efforts should also be made to track and to map investments in these other planning and management efforts in order to make a more comprehensive assessment of marine and coastal conservation. This should include the building of global or regional datasets of marine spatial planning and integrated coastal management efforts.

In this paper it is argued that a clearer vision of spatial conservation opportunities is needed to ensure that the ocean generates enduring benefits. In moving towards such a vision, a much clearer articulation of the challenges and the opportunities is recommended. This includes more effectively demarcating the kinds of protection that should be counted toward meeting national and international

targets, and developing clear and objective ecological, social and economic indicators to reduce current ambiguity, which is hampering much needed progress. Greater clarity of purpose and precision from spatial planning must guide both the conservation and sustainable development communities to truly conserve the most important marine areas across the world's oceans and coasts, generating enduring environmental and social benefit for the planet and its people.

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