4

Systematic Conservation Planning as a Tool to Advance Ecologically or Biologically Significant Area and Marine Spatial Planning Processes

Linda R. Harris, Stephen Holness, Gunnar Finke,
Stephen Kirkman, and Kerry Sink

1 Introduction

It is no coincidence that human population densities are three times higher along coastal margins compared to the global average (Small and Nicholls 2003). People love the sea. It features prominently in many cultures, traditions, myths and legends, with our connection ranging from occasional

---

L. R. Harris (✉)
Department of Zoology, Institute for Coastal and Marine Research, Nelson
Mandela University, Port Elizabeth, South Africa
e-mail: Linda.Harris@mandela.ac.za

S. Holness
Department of Zoology, Nelson Mandela University, Port Elizabeth, South Africa

G. Finke
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH,
Swakopmund, Namibia

S. Kirkman
Oceans and Coasts, Department of Environmental Affairs,
Cape Town, South Africa

K. Sink
South African National Biodiversity Institute, Cape Town, South Africa

Institute for Coastal and Marine Research, Nelson Mandela University,
Port Elizabeth, South Africa

J. Zaucha, K. Gee (eds.), *Maritime Spatial Planning*,
https://doi.org/10.1007/978-3-319-98696-8_4

holidays through to complete dependence for livelihoods. Unsurprisingly, use of the abundant and rich resources and services provided by the global oceans has escalated rapidly, with increasing and diversifying ocean-based resource extraction, shipping and trade, and recreational activities. Even in just a recent five-year period, nearly 66% of all oceans and 77% of Exclusive Economic Zones (EEZs) showed increases in cumulative impacts from anthropogenic activities (Halpern et al. 2015).

With increasing uses and users of the ocean comes increasing conflict. This conflict exists as both user-user conflicts, where competing sectors require use of the same space, and user-environment conflicts, where an activity negatively impacts the natural environment. Studies that sought to reduce these conflicts have shown the benefits of zoning the ocean in space and time. They demonstrated that a planned use of the marine environment can minimise losses and maximise gains for conflicting sectors whilst still protecting and conserving the underlying ecosystems and their associated biodiversity (e.g., Klein et al. 2009; White et al. 2012). Thus, if all users are willing to compromise and perhaps forego some of their ideals in cases of unavoidable conflicts, the overall outcome is that many more objectives can be achieved and many more benefits won.

The challenge, therefore, is to develop science-based methods that can help resolve as many of these conflicts in an open, fair and robust way, such that social, economic and ecological objectives can be met in a single solution. This chapter considers two existing tools—Ecologically or Biologically Significant Areas (EBSAs) and Marine Spatial Planning (MSP)—and describes how Systematic Conservation Planning (SCP) can advance and link these two processes. The efficacy of this SCP approach is discussed in the context of developing countries currently seeking sustainable ocean-resource use whilst simultaneously aiming to grow their national economies. The broad applicability of the method is also showcased by including countries with contrasting data availability. The International Union for Conservation of Nature (IUCN) definition of a "Protected Area" (PA) is used throughout, with "reserve" referring to the stricter Category 1a and 1b PAs (see Dudley 2008).

2 Spatial Prioritisation and Planning

2.1 Lessons from Land

The discipline of land-use planning has a much longer history than that of sea-use planning, providing opportunity for the latter processes to learn from what has gone before and to build on what is currently considered best practice. Further, our understanding of the relationship between humans and the environment has grown substantially in the last few decades. Prior to the 1960s, humans were considered separate from the environment; conservation was framed as "nature for itself", with areas of wilderness locked away in reserves (Mace 2014) and the remainder seen largely as available for almost any other human use. Placement of these reserves was generally ad hoc, often in areas unsuitable for productive agriculture or human habitation, and mostly ignored fundamental conservation issues such as biodiversity representation (Pressey 1994). In hindsight, this was an inefficient strategy. Despite the very low opportunity cost and limited conflict with other sectors, reserve networks spanned a much larger area than was required to achieve the same conservation benefits, with the additional disadvantage of carrying higher operational costs (Pressey 1994).

Over the turn of the century, we have progressed through periods of framing conservation as "nature despite people", where avoiding extinction and loss was our focus; to "nature for people", as the value of ecosystem services was recognised and explored; to "people and nature", where people are now considered part of ecological systems (Mace 2014). No longer is the focus on those isolated reserve "islands" in a landscape we were otherwise content to modify at will. Rather, we recognise the need to create shared landscapes between people and nature, with strong emphasis on maintaining ecological processes, adaptability and resilience in this social-ecological space (Dudley 2008; Mace 2014).

This modern framing of conservation and management is exemplified in South Africa, where the term "conservation planning" was replaced with "biodiversity planning" among practitioners and in policy. The former term was widely misinterpreted as strictly reserve design and PA expansion, whereas the intent was rather spatial prioritisation for land-use planning and decision-making. In this process, SCP is used to identify priority areas for biodiversity (Critical Biodiversity Areas [CBAs] and Ecological Support Areas [ESAs]), a desired state or management objective is set for these areas, and then activities compatible with achieving or maintaining that state are specified (SANBI 2017). Although only a subset of CBAs are PAs, biodiversity in all CBAs receive some form of protection because of the additional policies and regulations in place to regulate activities within them. ESAs are similar, although the focus in such areas is more on maintaining ecological processes that support ecosystem form and function, particularly for safeguarding biodiversity in CBAs and delivering ecosystem services, for example, corridors along which species can migrate in response to climate change. Some ecosystem modification is permissible in ESAs, provided the ecological condition of the site remains above a specified threshold.

It is only recently that our growing contemporary viewpoint is that people are part of nature and not separate from it—neither are we the sole benefactors of what nature provides. Best practice in conservation and land-use planning is now understood to be managing landscapes as social-ecological systems using multidisciplinary processes that aim to achieve social, economic and ecological objectives in an open, fair and transparent way (Ban et al. 2013). Formal reserves still, and will always, have their place. However, there is much more emphasis today on using the land "beyond the fence" more coherently and sustainably, such that ecosystems retain their resilience and adaptive capacity, especially in the face of accelerating global change.

2.2 Application in the Sea

> Aichi Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes. (Convention on Biological Diversity 2011)

MSP is a modern solution to a modern problem, so it reflects our contemporary understanding of conservation and management, described earlier. It is considered "a practical way to create and establish a more rational organisation of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect marine ecosystems, and to achieve social and economic objectives in an open and planned way" (DEFRA 2008, cited in Ehler and Douvere 2009). It explicitly aims to analyse and allocate parts of the ocean to the various human uses, in both space and time, in such a way that it reduces conflict and achieves social, economic and environmental objectives (Ehler and Douvere 2009; see also Chap. 1 of this book).

MSP initiatives invariably have a strong political or government-driven process behind them, with the intent of achieving an overarching goal—usually sustainable development (Gilliland and Laffoley 2008). To succeed, MSP must adopt principles of ecosystem-based management. Critically, therefore, a core objective in the plan must be to maintain the underlying environment "in a healthy, productive and resilient condition so that it can provide the services humans want and need" (McLeod et al. 2005). Safeguarding biodiversity is thus the foundation of sustainable development: the demands placed on the ocean space must not exceed its capacity to provide and meet those demands (Gilliland and Laffoley 2008). Consequently, it is imperative that the MSP includes Marine Protected Area (MPA) networks and other effective area-based conservation measures to mitigate user-environment conflict. It cannot focus solely on resolving user-user conflict.

Given the lessons learnt in the terrestrial environment, the currently limited extent of MPAs globally (Sala et al. 2018) is a strong concern, but it could also be viewed as an opportunity. We are now poised to take the tools and principles we have learnt on land, adapt them for the sea and plan efficiently for a sustainable future, with biodiversity appropriately represented in complementary MPAs. In this way, we can avoid two important pitfalls: first, inefficient and insufficient MPA networks do not deliver optimal benefits; second, they may bring an illusion of accomplishment, with no perceived need for well-located MPAs. This provides a clear motivation to fully consider the biodiversity represented in sites and the potential benefits from MPAs rather than rushing to declare MPAs with limited biodiversity and ecosystem-service value simply to meet internationally agreed area-based targets. As on land, no-take reserves are one of several conservation and management tools and serve a critical role in safeguarding biodiversity. However, beyond reserves, it is important that we create shared seascapes with nature, zoning the ocean into areas that support activities compatible with the underlying biodiversity features such that, despite partial ecosystem modification, ecological form and function are maintained.

2.3 The Role of Ecologically or Biologically Significant Areas

At the seventh Convention of Parties (COP 7) to the Convention on Biological Diversity (CBD) in 2004, an Ad Hoc Open-Ended Working Group on Protected Areas (hereafter, Working Group) was established, inter alia, to explore options for establishing MPAs in Areas Beyond National Jurisdiction (ABNJ) in a way that was science based and consistent with international law. After a series of meetings and discussions, the Working Group proposed the concept of Ecologically or Biologically Significant Marine Areas (EBSAs; see Dunn et al. 2014 for a full history), which has since been applied in areas under national jurisdiction as well.

The intent of a global MPA network is "To maintain, protect and conserve global marine biodiversity through conservation and protection of its components in a biogeographically representative network of ecologically coherent sites" (UNEP-CBD 2007, 2009), where EBSAs (with enhanced management) were intended to be a core part of the initial steps towards identifying and creating this network (UNEP-CBD 2007). The Working Group proposed seven criteria by which EBSAs are evaluated. Candidate sites are ranked (as high, medium or low) for their uniqueness or rarity; special importance for life history stages of species; importance for threatened, endangered or declining species and/or habitats; vulnerability, fragility, sensitivity or slow recovery; biological productivity; biological diversity; and naturalness—they must meet at least one of these to qualify as an EBSA (UNEP-CBD 2007, 2009). At COP 9, the criteria were adopted by the CBD, and it was also noted that MPA networks needed to take into account EBSAs; biodiversity representation across a suitable bioregionalisation; connectivity among sites; replication of features; and adequacy and viability of sites (UNEP-CBD 2007, 2009). However, very little guidance was provided on how countries ought to do this, other than "iteratively use qualitative and/or quantitative techniques" (UNEP-CBD 2007).

Following adoption of the criteria, the CBD Secretariat arranged workshops to assist countries and regions in identifying EBSAs, with the first set of EBSAs formally recognised at COP 11 in 2012. Today, 279 EBSAs are recognised worldwide (Johnson et al. 2018). Importantly, EBSA status itself does not require any conservation, protection or management interventions. However, at COP 10, in 2010, governments were encouraged to cooperate to identify and adopt appropriate conservation and sustainable-use measures in EBSAs within their EEZs and territorial waters, including establishing networks of representative MPAs. In this way, countries could potentially use EBSAs to identify areas for formal protection towards achieving Aichi Target 11. Additionally, negotiations are underway towards an instrument under which marine biodiversity (e.g., in EBSAs) could be protected in ABNJ (UN General Assembly 2017), such that these important areas could also contribute towards the global MPA network.

How countries identified EBSAs at the workshops was largely an expert-based approach. Although the seven criteria do make EBSA identification systematic to some degree and the principles for network design are useful, the loose guidance for applying these makes it difficult to assess if networks of EBSAs or MPAs are indeed sufficiently representative, connected, replicated, adequate and viable (see also Bax et al. 2016). These are especially important shortcomings if EBSAs are the mechanism that a country might choose to underpin their national MPA networks towards achieving Aichi Target 11 and perhaps ultimately for similar targets to be met in ABNJ.

To this end, further development of the EBSA process was encouraged at COP 13 in 2016. Some research teams have attempted this, for example, by advocating for a multi-criteria approach with thresholds per criterion conducted for separate habitat types (Clark et al. 2014). Exploring different methods for applying the criteria is needed to advance this aspect of the EBSA process. However, a multi-criteria analysis, particularly on a per-habitat basis, still does not give an indication if the replication and representation is sufficient; does not account for complementarity, which will be essential for conservation efficiency in the MSP context; does not address issues of connectivity, among both ecosystem types or biodiversity features and EBSAs in the network; and is strongly dependent on data to evaluate the criteria against the set thresholds.

Another gap in the EBSA process is that there is currently no system in place to identify and recognise areas that are not EBSAs in their own right but still need special management because they support ecosystem (and EBSA) function and contribute to securing long-term persistence of biodiversity features and processes. These areas are much like the ESAs in South African terrestrial biodiversity planning. Nevertheless, with appropriate conservation and management measures, EBSAs could easily be the tool by which countries can achieve internationally codified conservation targets. They could also form the ecological basis of an ecosystem-based MSP. This provides a key imperative to address the shortcomings in the current EBSA process, notably around biodiversity representation and persistence.

2.4 Systematic Conservation Planning: The Tool for the Job

SCP is a spatial prioritisation tool that supports decision-making about actions (usually with limited resources) that optimise benefits for biodiversity at the least cost to society. It is based on two key objectives: representation and persistence (Margules and Pressey 2000); biodiversity must be adequately represented in comprehensive PA networks such that species, features and processes can persist in perpetuity. This framing requires the conservation problem to be spatially explicit and target driven (recognising that non-target-based approaches have also been developed, e.g., Zonation; Moilanen et al. 2009).

SCP software, for example, Marxan (Ball et al. 2009), generally relies on an optimisation algorithm. Thus, it has strong focus on using the principle of complementarity to achieve the user-defined targets in the most efficient spatial configuration. However, because planning is for real-world implementation, the distribution of other activities within the planning domain must be accounted for: the fewer conflicts proposed PAs create with existing uses and users, the greater the likelihood of implementation. Thus, where options exist to meet biodiversity targets in areas that have no or few competing uses, those sites should be preferably selected. Consequently, SCP algorithms are designed to select sites with biodiversity value in a configuration that meets targets for biodiversity representation in the most spatially efficient way, avoiding competing land or sea uses where possible. Plans also need not focus solely on delineating conservation areas. For example, SCP tools have been very successful in zoning the oceans to optimise both socio-economic and conservation objectives simultaneously (e.g., Klein et al. 2008).

Comprehensive cover of biodiversity (at all organisational levels) in a planning domain is often an unrealistic ideal, forcing planners to use surrogates, typically habitats or ecosystem types, with some additional key biodiversity features, such as threatened species, unique features and important ecological processes. Setting targets for biodiversity features is often a contentious debate, with options ranging from codified targets, such as Aichi Target 11, to species- or ecosystem-specific targets based on minimum viable population sizes or species-area curves. How rigorously targets need to be addressed may depend on the nature of the planning problem. However, experience has shown that pragmatic decisions can circumvent issues like “how much is enough”, and that adopting heuristic or codified targets provides an excellent, practical solution in the interim until better information becomes available. This is particularly the case when protection levels are well below any target (i.e., near zero, as is generally the case in the oceans). Finding optimum targets matters more when protection levels might be approaching those values.

SCP deliberately incorporates past conservation efforts and seeks to find complementary solutions to existing PA networks, thereby minimising any inefficiency in past ad hoc delineations. Further, because the spatial prioritisation problem is solved using an algorithm that was designed to be a scenario-planning, decision-support tool, it can generate multiple alternate solutions among which decision-makers can choose and trade-offs analysed and compared (Harris et al. 2014b). This flexibility in finding solutions across the planning domain is also very powerful for negotiations. In cases where some PA sites are acceptable to stakeholders and others rejected, the algorithm can be rerun with the acceptable portions hardwired into the final solution, and alternative areas sought to meet the remainder of the biodiversity targets. Another benefit is that the site-selection frequency can be used to guide delineation of both core areas for conservation and supporting areas. The outputs can also be interrogated to determine reasons for site selection. In turn, this could be used as a robust guide for management and stakeholder negotiation: knowing which biodiversity features are meeting their targets in a particular area will give an indication as to which activities are compatible and thus locally permissible.

The current shortcomings highlighted in the EBSA identification and delineation process thus appear to fit the strengths of SCP. Using this spatially explicit, target-driven tool could assist in selecting sites that are more representative of biodiversity and address replication, connectivity, adequacy and viability. Emphatically, the SCP process does not replace the criteria-based EBSA identification process in any way. Rather, it provides a more robust method of applying the criteria than expert judgement alone (see Table 4.1). The additional benefits of the SCP approach are as follows: first, it explicitly addresses the objective of creating a “biogeographically representative network of ecologically coherent sites” (UNEP-CBD 2007, 2009); second, it inherently seeks conflict avoidance, making implementing the encouraged conservation and sustainable-use measures within EBSAs more likely.

At this point, undertaking data-driven SCP to identify EBSAs may seem ideal but entirely impossible in data-poor areas where no maps exist on which to base the planning. With this in mind, the Benguela Current Large Marine Ecosystem (BCLME) in Southern Africa provides a robust test of using SCP to advance EBSA and MSP processes. On the one hand, South Africa is one of the global leaders in SCP (Balmford 2003) and thus has comprehensive spatial data available for the marine environment (Sink et al. 2011; Majiedt et al. 2012; Sink et al. 2012). On the other hand, Namibia and Angola do not have the required data available on which planning can be based. Further, data issues notwithstanding, there is a very clear and recognised need for MSP to enhance sustainable development in this region, with legislative frameworks currently being developed.

3 Spatial Planning in the Benguela Current Large Marine Ecosystem

3.1 One of the Most Productive Marine Areas in the World

The BCLME spans the West African Coast, including the EEZs of Angola, Namibia and the west coast of South Africa (Fig. 4.1). It is one of the four

Table 4.1 SCP elements that link to each of the seven EBSA criteria

EBSA criterion	SCP element
Uniqueness or rarity	Unique sites or features are considered as "irreplaceable" in an SCP context, and thus will always be selected because they are the only place where targets for that feature can be met.
Special importance of life history stages of species	Usually, these sites of importance are included in the spatial prioritisation as an explicit feature (e.g., turtle nesting beaches) with a representation target.
Importance for threatened, endangered or declining species and/or habitats	All habitat types and species that are included in the spatial prioritisation have their own representation target. Features (habitats, species) that are threatened or declining will have few options where these targets can be met, and thus will have high selection frequency. The ecosystem threat status analysis that follows the condition assessment (see Sect. 3.4) can also contribute to this criterion.
Vulnerability, fragility, sensitivity or slow recovery	This criterion is accounted for in two possible ways. For species, they could be included as a separate feature with a representation target (e.g., vulnerable marine ecosystems). For habitats, the cumulative pressure assessment explicitly scores recovery time as one of the assessment metrics.
Biological productivity	Productivity can be included either as a map of chlorophyll-*a* intensity (or similar), from which the areas with higher values will be preferentially selected to meet targets, or it could be included as a feature map of upwelling cells with a representation target.
Biological diversity	Sites with high biological diversity can be mapped either as a separate feature with a target or if multiple biodiversity layers are included in the spatial prioritisation, then diverse areas will be preferentially selected because they are efficient sites in which biodiversity targets can be met.
Naturalness	This is accounted for in the site condition assessment, where sites in good condition (less degraded) are preferentially selected over sites in fair or poor condition where the option exists.

major eastern boundary upwelling systems and one of the most productive marine areas globally (Heileman and O'Toole 2009). This productivity, coupled with strong contrasts in habitat types (Harris et al. 2013) concomitantly supports a rich diversity and great abundance of fauna and flora, and a high biomass of commercially important species. It includes unique features and species, supports key ecological processes and provides important ecosystem services. In short, the BCLME represents a system of global and regional importance that comprises a wealth of natural resources.

The three states thus rely strongly on the BCLME to sustain their national economies (Hamukuaya et al. 2016). In consequence, the region has high levels of commercial resource extraction, largely fishing and mining, with ocean-based economic development set to increase further through national

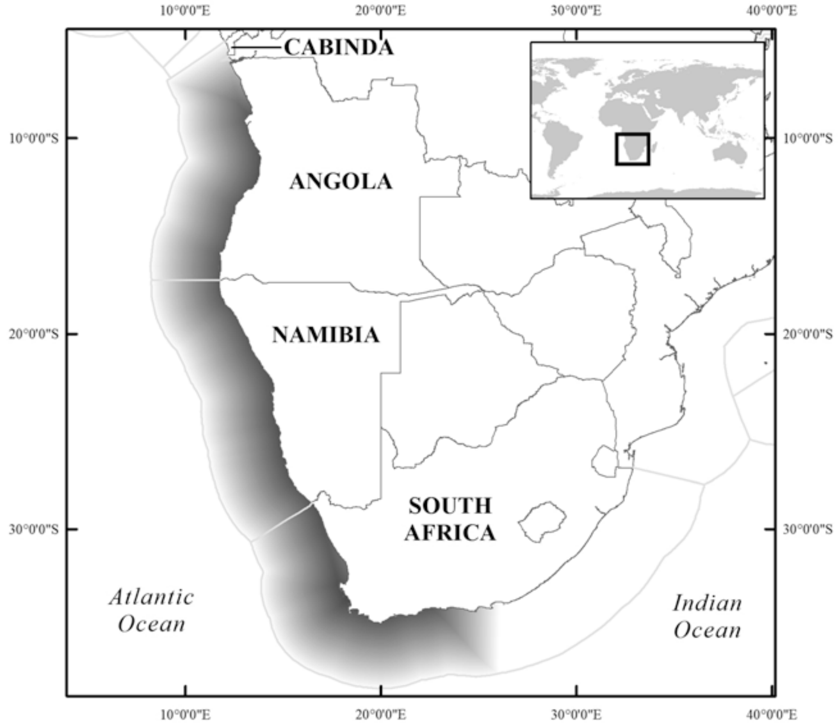

Fig. 4.1 The Benguela Current Large Marine Ecosystem (shaded grey) includes the EEZs of Angola, Namibia and western South Africa in the south-east of the Atlantic Ocean. Note that Cabinda is an exclave of Angola. World EEZ (version 6) boundaries available from http://marineregions.org/. For BCLME region, see BCC (2014)

and regional initiatives. These initiatives include the Benguela Current Convention's (BCC) Strategic Action Programme 2015–2019 (BCC 2014) and Operation Phakisa in South Africa (Republic of South Africa 2014) and are backed by strong government support and political will.

Although there are very clear socio-economic benefits intended through these development strategies, there are also notable ecological concerns of intensifying the current pressure levels on the BCLME. Already this significant system is under threat from existing resource extraction (Boyer and Hampton 2001) and associated pressures, for example, from ports and shipping, coastal development and various forms of pollution (Holness et al. 2014). These are compounded by global-change pressures that, inter alia, are shifting species distributions with knock-on effects through food webs that are stressing further the already threatened top predators (e.g., Pichegru et al. 2010). However, we have never been in a position that is as strong as it is today to take cognisance of the system-level complexity and plan for a sustainable future. Given the key role that the BCLME plays in the three respective countries, and in global ecological processes, safeguarding this natural capital for the generations to come is both imperative and a moral obligation to our children's children.

3.2 Ecosystem-Based Sustainable Development for the Benguela Current Large Marine Ecosystem

Recognising the need for sustainable development and ecosystem-based management, the three countries ratified the BCC (BCC 2013). Building on a strong history of cooperative governance in the BCLME (Hamukuaya et al. 2016), the BCC has taken a proactive role in developing robust conservation and management strategies for the region. One of their first projects was a Spatial Biodiversity Assessment that aimed to design a Spatial Management Plan for the BCLME as a whole, including identification of priority areas for MPAs (Holness et al. 2014). This was followed with a (current) regional cooperation project: The Marine Spatial Management and Governance Project (MARISMA), 2014–2020. The aims of MARISMA are to build capacity in the BCC and its contracting parties and for them to contribute to the sustainable management of the Benguela Current's marine biodiversity and marine natural resources. In so doing, MARISMA intends to directly support countries to achieve their obligations as signatories to the CBD.

The approach taken in the MARISMA Project is to safeguard the natural capital of the BCLME by identifying EBSAs for effective management, including conservation and protection, in a region-wide MSP that allows for socio-economic development in a sustainable manner. Consequently, there are three work areas in the MARISMA Project: the EBSAs' work stream informs the MSP work stream, which is supported by the cross-cutting focus on capacity development, awareness raising and dissemination of results, experiences and products. The case study in this chapter focusses largely on the EBSA work stream of the MARISMA Project and the role that SCP can play in advancing EBSA delineation and integration into MSP processes.

3.3 Ecologically or Biologically Significant Area Identification and Delineation

The first of the CBD's regional EBSA identification workshops was held for the Western South Pacific and the Wider Caribbean and Western Mid-Atlantic Regions in 2011, resulting in 47 EBSA being adopted at COP 11 in 2012. The success of the process led to seven more regional meetings the following year, including the South East Atlantic (SEA) and the Southern Indian Ocean (SIO) Regional Meetings, at which EBSAs in the BCLME and the rest of South Africa were identified, respectively. At COP 12 in 2014, 157 more EBSAs were adopted, including 12 from the BCLME (and an additional seven in the SIO portion of South Africa). Given that EBSA identification was an expert-based approach, delineation of the focus areas was largely coarsely done, with the boundaries poorly linked to the shape of the underlying biodiversity features (Fig. 4.2). Further, South Africa had many more EBSAs in the BCLME region compared to those in Namibia and Angola, simply because spatial prioritisation for marine biodiversity in the former country was already well underway (Sink et al. 2011; Majiedt et al. 2012).

The BCLME case highlights clearly the inherent pitfalls of the expert-based EBSA identification and delineation process. We support the sentiment that progress should not be delayed in the search for refined data and perfect processes (Johnson et al. 2018). However, we also acknowledge that, although excellent for providing a pragmatic first step and guiding larger-scale prioritisation and management, the rough boundaries of the EBSAs are too coarse to be useful for integration into any Spatial Management Plans that also need to

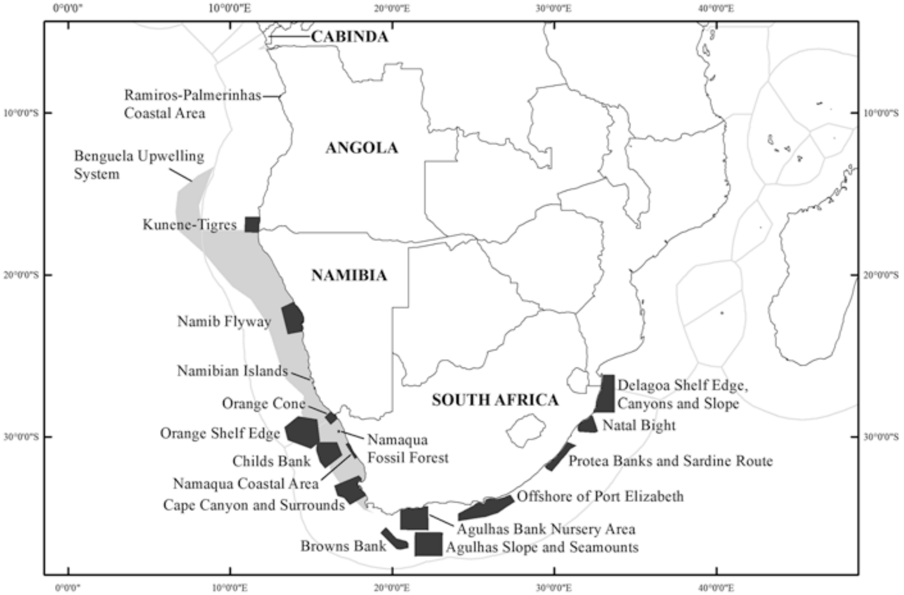

Fig. 4.2 Original set and delineation of EBSAs adopted for the BCLME and SIO portion of mainland South Africa within the respective countries' EEZs. EBSAs in the surrounding high seas are excluded, except for the Benguela Upwelling System EBSA (light grey) that falls mostly within the BCLME. World EEZ (version 6) boundaries available from http://marineregions.org/. For EBSA boundaries, see https://www.cbd.int/ebsa

include other stakeholders. Further, the current EBSA networks are not necessarily representative of the local or regional biodiversity patterns and processes and might, rather, reflect a country's progress in marine conservation initiatives. Ultimately, using the ad hoc, expert-based approach, there is no way to assess with confidence that a proposed EBSA network captures all important sites for a sufficient sample of the region's biodiversity.

As discussed in Sect. 2.4, SCP is proposed to be a particularly useful tool to address these pitfalls. However, the foundation input layers were not available for the three countries. Notably missing was a comprehensive map of ecosystem types across the region that could serve as the primary surrogate of marine biodiversity for the BCLME. Despite this, it is possible to build such datasets with limited information and resources. Coastal habitat types can be mapped from Google Earth imagery (Harris et al. 2013), and offshore habitat types can be delineated by combining bathymetric data (e.g., from the General Bathymetric Chart of the Oceans (GEBCO), available at: www.gebco.net) with a pelagic bioregionalisation based on a cluster analysis of multiple physical variables that can be measured using remote sensing (Roberson et al. 2017).

The benefit of these desktop approaches to mapping ecosystem types is that the bulk of the underlying data are freely available online. Where in situ data from field-based surveys exist, these can easily be incorporated into the ecosystem-type map, either as an independent ground-truthing dataset or to help delineate biotopes or seascapes (Karenyi et al. 2016). Key features, such as seamounts, can also be included from either existing spatial datasets (Yesson et al. 2011) and/or mapped specifically for the project. The additional feature detail in the final output map depends entirely on what is available, but it must be comprehensive in coverage, delineated at an appropriate spatial scale and integrated into one single map product.

The second input dataset that is required is a cumulative pressures map from which ecosystem-type condition can be assessed. If only a limited portion of the sea is allocated for conservation protection, it is preferable for targets to be met in places where the features are in a good ecological condition, meaning that biodiversity and ecological processes are still well intact at the selected sites. The premise is that the more activities there are at a site, and the greater intensity of the respective activities, the more degraded a site becomes (i.e., lower naturalness). It is fully recognised that the complexities of interactions among pressures—positive, neutral and negative—are not accounted for in this approach, but it is a sufficiently robust assumption to make for this assessment where site condition is a relative measure. As for the ecosystem type map, this input layer needed to be custom built for the BCLME.

Raw data on the distribution and intensity of activities and pressures can be sourced from the various industries and sectors through stakeholder engagement: workshops, formal data requests and in-person visits to key data holders. Datasets could include fishing effort and catch, shipping lanes, mining locations and volumes of wastewater discharge out of different pipelines, some of which data are freely available online. Aggregating the suite of pressure data largely follows the cumulative threat assessment methodology developed by Halpern and colleagues (Halpern et al. 2007) that has since been broadly applied (Halpern et al. 2008; Sink et al. 2012; Halpern et al. 2015). These data were sourced from industries in the BCLME (Holness et al. 2014), but if no data exist, a country could use the data from the global assessments (Halpern et al. 2008, 2015) or online databases (e.g., ICCAT 2018).

In this method, each pressure is mapped to a predetermined grid, and pixel values are assigned as the intensity of each activity scaled from 0 to 1, with the upper tail cut at the 80th (or similar) percentile such that all values above that threshold are scored as 1. The size of the grid pixels depends on the resolution of the input data and size of the planning domain, with a 5’ grid commonly used in national or regional marine plans. The functional impact and recovery time of a pressure to a particular ecosystem type is scored (by experts, supported by published studies where available), with that score multiplied by the intensity of each pressure in each pixel depending on which pressure-ecosystem combinations are present. Finally, the values are summed per pixel to give an overall cumulative pressure score per pixel across the whole planning domain. Based on these cumulative pressure scores, condition can be ranked as good, fair or poor, where biodiversity pattern and process are, respectively, intact, degraded or lost (Sink et al. 2012).

The third fundamental input layer is a map of existing PAs. As discussed in Sect. 2.4, SCP is definitively efficient and seeks to incorporate existing conservation action and meet outstanding targets in complementary areas. Countries may have these datasets readily available, but if not, the World Database on Protected Areas serves a free global map (available at https://www.protectedplanet.net). Therefore, even if countries start the process with seemingly no data, the three primary maps on which SCP-based EBSA identification is based can be constructed largely from freely available data. In other words, the simplest form of SCP can be used to delineate EBSAs in any country, anywhere in the world.

Of course, the more data available, the more planners can be confident that the EBSA network adequately represents all important sites for a sufficient sample of the region's biodiversity. Although a very good surrogate of biodiversity patterns and processes, ecosystem types may not adequately account for or highlight areas that are important for particular life-history stages, such as breeding and foraging grounds of top predators and migratory species. Any additional biodiversity data such as key species' distributions, internationally recognised sites (e.g., World Heritage Sites, RAMSAR Sites, Important Bird and Biodiversity Areas), areas of high diversity and areas that support key ecological processes can also be included as input datasets. These data were collated for the BCLME (Holness et al. 2014).

The final required input layer is a cost map. There are many ways in which this "cost" can be defined and quantified, but at its core, it represents the penalty to other stakeholders within the planning domain if a site is selected for conservation. This could be measured as opportunity cost, the market value to purchase an area or some other metric that gives a relative indication of potential conflict over a site. In the BCLME context, cost was customised per country to reflect socio-economic priorities from their respective key industries (Holness et al. 2014).

The next step in the process is to compile a list of representation targets for each of the input features. Planners are strongly encouraged to avoid the "target trap" in target-driven SCP (SANBI & UNEP-WCMC 2016). Although it is certainly ideal to have empirical targets derived for each input feature based on their detailed ecological requirements (Desmet and Cowling 2004; Harris et al. 2014a), heuristic or codified values do work especially well, as discussed in Sect. 2.4 earlier. For ecosystem types, planners often set the target at 20% of the historical extent and slightly higher for biodiversity features and ecological processes (Holness et al. 2014); Aichi Target 11 would also work well as a starting point.

With the four key maps and a list of targets, planners can then run SCP software, such as Marxan (Ball et al. 2009), to identify networks of areas that may qualify as meeting the EBSA criteria. The most useful output from Marxan is the selection frequency map, which sums the number of times an area is selected to meet targets out of a user-defined number of repeated runs of the algorithm. Thresholds of selection can be used to identify potential EBSAs (e.g., selection frequency of >80%), with those areas iteratively locked into the solution, along with the existing PAs, until all targets are met. Planners may also wish to include areas of lower selection frequency that serve as ESAs, or "support EBSAs", such as those with a selection frequency of >65%, to ensure persistence of the biodiversity features within the planning domain.

This process can also be repeated iteratively in a stakeholder negotiation process, and/or stakeholders can be presented with a series of candidate EBSA network options and what they might be trading off if one option is selected over another (Harris et al. 2014b).

The SCP approach allows candidate EBSAs to be delineated in a way that matches the underlying biodiversity features much more closely than the current, largely geometric shapes drawn by experts over the broader focus area. This carries three benefits for easier adoption into MSP processes: first, they are not "spatially greedy" areas that unnecessarily exclude other stakeholders from an area; second, they have been designed deliberately to avoid conflict with competing sectors as far as possible through inclusion of those industries in the condition assessment and cost layer; and third, the design is science based and thus easier to defend when challenged by other stakeholders in a negotiation. The latter is an especially important point that has similarly motivated others to improve application of the criteria to strengthen the transparency and robustness of EBSA delineation (Clark et al. 2014).

3.4 Ecologically or Biologically Significant Area Status Assessment and Management Options

With the data inputs described earlier, planners can easily undertake two ecosystem-level assessments that can serve as headline indicators: threat status and protection level (SANBI & UNEP-WCMC 2016). The proportion of each ecosystem type evaluated as good, fair or poor is compared against specific thresholds from which the threat status is assigned. Ecosystem types are said to be Critically Endangered when the proportion in good condition is less than or equal to the biodiversity target (in the BCLME case, 20%). Endangered systems should trigger a warning and are thus recommended to be the biodiversity target +15% (i.e., in the BCLME case, 35%). Vulnerable and Least Threatened ecosystem types have more generous thresholds: in the BCLME case, Vulnerable ecosystem types have <80% of their historical extent in good or fair condition; Least Threatened, >80% (Holness et al. 2014). The second headline indicator is protection levels, where the proportion of each ecosystem type that is protected is determined relative to its target, and the ecosystem type is assigned a rank of well, moderately, poorly or not protected. At this point, the outputs can be interrogated and proposed EBSA descriptions prepared for consideration by the CBD, with a strong scientific basis for the criteria ranks from the SCP process (refer to Table 4.1).

3.5 Integrating Ecologically or Biologically Significant Areas into Marine Spatial Planning Processes

Summary statistics of the earlier indicators can be calculated per EBSA and used to guide conservation and management actions, for example, if an EBSA contains ecosystem types that are poorly or moderately protected, the management action might be to proclaim the EBSA as an MPA and apply relevant management measures. Ecosystem types that need notable intervention are those that are both threatened and not well represented in MPAs. Each individual EBSA could also be assessed to determine the reasons for its selection during the SCP process by identifying the features it contains, site cost and condition, which in turn will help guide sea use in that area (see also Dunstan et al. 2016). For example, if a site is selected because it contains key benthic features, the EBSA could be zoned as a special management area where benthic trawling is prohibited but large pelagic longlining is permitted, depending on the activity-feature compatibility.

Once conservation and management recommendations per EBSA are listed, these can be very easily integrated into an MSP. Recall that to legitimately achieve sustainable use of marine resources, it is critical to first secure the natural capital from which the production services flow. This might mean reserve proclamation for some EBSAs but could also take the form of a restricted-use area (e.g., IUCN PA Categories V or VI) where only activities compatible with the local biodiversity features are allowed. The latter might be especially relevant for “support EBSAs” or ESAs, and in such cases, the suite of compatible activities listed for that area (as extracted from the SCP process) could guide and inform MSP negotiations around user-environment conflicts. Stakeholders and decision-makers need to remain cognisant of the need to secure the nature capital during negotiations, such that short-term socio-economic gains do not come at the expense of long-term losses, for both nature and people (Harris et al. 2018). It has been argued previously that EBSAs could be used to implement MSP through an adaptive hierarchical framework (Dunstan et al. 2016). The process presented in this chapter provides a simpler, spatially explicit variation of the EBSA-MSP integration to achieve ecosystem-based management. This spatialisation of the planning problem (gained through the SCP approach) is proposed here to be one of the most important steps in achieving sustainable development.

3.6 Progress in the Real World

Although the MARISMA Project is still ongoing, progress towards the final outcomes is well underway. EBSA boundaries have been refined and supporting ESAs identified (Fig. 4.3a). Further, Operation Phakisa in South Africa is supporting MPA proclamation, with 22 MPAs gazetted for public comment in 2016 (Republic of South Africa 2016). If proclaimed, they would take the country from <0.4% to 5% marine protection, with a further 5% protection to follow that would then fulfil South Africa's obligation to achieve Aichi Target 11. These MPA boundaries were derived from the ongoing spatial prioritisation (SCP) in the country (Sink et al. 2011; Majiedt et al. 2012) that had also supported the EBSA identification. Consequently, the proposed MPAs will contribute to securing the critically important biodiversity features within the EBSAs (Fig. 4.3b).

The SCP method and outputs have been invaluable during negotiation with industries that have competing interests within these proposed MPAs. As described earlier, it is allowing for iterative boundary refinement throughout the negotiation process. Further, it allows site-specific interrogation of the biodiversity features and key threatening activities within the sites such that stakeholder negotiation and MPA regulations can be targeted, transparent and informed (Fig. 4.3c). Once the ESAs are identified, it is envisaged that these will be integrated in the national emerging MSP, with restrictions on threatening activities in the remaining portions of the EBSAs and in the ESAs such that key marine biodiversity pattern and process is safeguarded for the future.

4 The Value Added by Taking a Systematic Conservation Planning-Based Approach

Inevitably, the success of any MSP will depend on implementation and compliance. The more governments and stakeholders are engaged in the planning process, the greater their sense of plan ownership, and the higher the likelihood that oceans will be developed sustainably. It is important to recognise that political involvement in EBSA delineation and integration into MSP does not mean that the scientific process is compromised if SCP is the decision-support tool. Rather, SCP advances empirical ecosystem-based MSP in the real world through the following seven attributes.

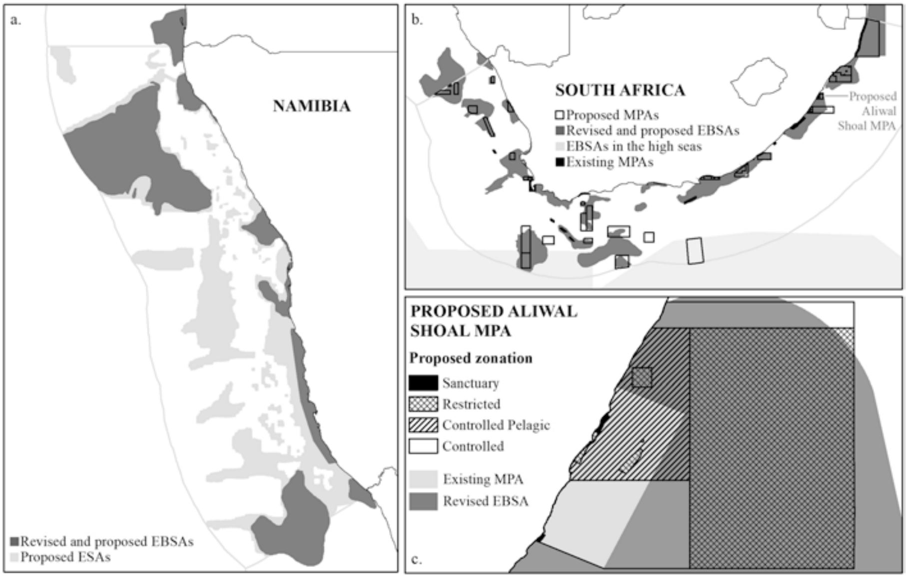

Fig. 4.3 Illustration of the advances in EBSA and MSP processes that can be achieved by SCP. (**a**) Draft revision of existing EBSAs and proposed EBSAs and ESAs in the Namibian EEZ designed using SCP; (**b**) existing and proposed MPAs as gazetted (Republic of South Africa 2016) relative to the revised and proposed EBSAs in South Africa (note that the two EBSAs in the adjacent high seas are also shown in light grey); and (**c**) example of the site-level interrogation of SCP inputs and outputs that can guide both MPA regulations and spatial management of activities in the rest of the EBSA and surrounding areas. In this case, the SCP accounted for existing protection provided by the Aliwal Shoal MPA by including that area in the new delineation of proposed MPAs (and proposed revision of EBSA boundaries). The SCP data supported fine-scale planning of the proposed zonation of the proposed MPA, with the different zones allowing only those activities that are compatible with the underlying biodiversity features. This application could be extended through all EBSAs in an MSP to minimise user-environment conflicts; beyond MPAs and EBSAs, the MSP could focus on resolving only user-user conflicts. Refer to the Government Gazette (Republic of South Africa 2016) for full details on the proposed MPAs, draft regulations and allowed activities per proposed zone. World EEZ (version 6) boundaries available from http://marineregions.org/. Proposed MPAs from Republic of South Africa (2016)

1. SCP supports the key goal of a sustainable ocean system through identification of the most important areas required for securing representation and persistence of ocean features. In so doing, it contributes to securing the natural capital by prioritising sites for conservation action.
2. SCP is underpinned by quantitative targets. This allows easy alignment with CBD, Aichi or any other codified targets, and it helps address the question of sufficiency.

3. SCP is definitively spatially explicit and spatially efficient. This is imperative in an MSP context where planners must balance the many requirements set by multiple stakeholders. The more spatially efficient each sector can be, the lower the chance of unnecessary conflict.
4. SCP specifically considers the potential effects that a conservation area would have on other activities and deliberately avoids spatial overlap as far as possible to facilitate reduced MSP negotiations over user-environment conflicts. The transparent process allows stakeholders to understand sector priorities and trade-offs.
5. SCP can rapidly develop and evaluate alternate scenarios or spatial management options, which is essential in a stakeholder negotiation process.
6. SCP allows identification of the specific pressures acting on specific high-value biodiversity features, which helps to move management action from generic approaches to being truly place based.
7. SCP helps to assess the qualitative EBSA criteria, which are currently ranked for a site as high, medium or low, with no quantitative guidance for what these relative measures mean. This, in turn, makes applying the criteria more consistent among EBSAs in different regions. Ultimately, it makes the EBSA identification and delineation process more science based.

From these attributes, SCP clearly has much to add to both EBSA and MSP processes. Data availability (or lack thereof) should not be seen as a hindrance to its application. As demonstrated through the BCLME case, it is possible to build the required datasets with relatively few resources, largely from existing spatial information that is freely available online. Planning can be as elegant or as simple as the data allow and still achieve robust outputs.

The complexity of governing modern society within a dynamic ocean space that has inherent large-scale connectivity necessitates innovative and creative solutions to conservation and management. These solutions need to allow socio-economic development in a three-dimensional environment, whilst still maintaining ecosystem health and function, all in the face of accelerating global change. Importantly, these solutions must follow good governance practices and thus must be transparent, fair and founded in robust, defendable science to the equitable benefit of all. At all times, we must retain cognisance of the consequences that the industrial revolution had on the environment, notably the acceleration in global climate change that it triggered. As we embark on a similar industrial revolution in the oceans, we have the opportunity to take what we have learnt and leave a sustainable legacy for future generations.

Acknowledgements The MARISMA Project is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through its International Climate Initiative (ICI) and further made possible through considerable in-kind contributions by the BCC and its contracting parties. It is implemented by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH; German Development Cooperation) in partnership with the BCC and its contracting parties. The authors thank the above consortium and the people behind it for enabling implementation of the MARISMA Project. They also thank the many scientists and regional workshop participants who have contributed to the SCP, EBSA and MPA processes in South Africa outside of the MARISMA Project. The Open Access fee of this chapter was provided by the project "Economy of Maritime Space" funded by the Polish National Science Centre.

References

Ball, I., Possingham, H., & Watts, M. (2009). Marxan and Relatives: Software for Spatial Conservation Prioritization. In A. Moilanen, K. Wilson, & H. Possingham (Eds.), *Spatial Conservation Prioritization*. Oxford: Oxford University Press.

Balmford, A. (2003). Conservation Planning in the Real World: South Africa Shows the Way. *Trends in Ecology & Evolution, 18*, 435–438.

Ban, N. C., Mills, M., Tam, J., Hicks, C. C., Klain, S., Stoeckl, N., Bottrill, M. C., Levine, J., Pressey, R. L., Satterfield, T., & Chan, K. M. (2013). A Social–Ecological Approach to Conservation Planning: Embedding Social Considerations. *Frontiers in Ecology and the Environment, 11*, 194–202.

Bax, N. J., Cleary, J., Donnelly, B., Dunn, D. C., Dunstan, P. K., Fuller, M., & Halpin, P. N. (2016). Results of Efforts by the Convention on Biological Diversity to Describe Ecologically or Biologically Significant Marine Areas. *Conservation Biology, 30*, 571–581.

BCC. (2013). Benguela Current Convention. The Secretariat, Benguela Current Commission, Swakopmund, Namibia. Retrieved from http://www.benguelacc.org/index.php/en/publications.

BCC. (2014). Strategic Action Programme 2015–2019. The Secretariat, Benguela Current Commission, Swakopmund, Namibia. Retrieved from http://www.benguelacc.org/index.php/en/publications.

Boyer, D. C., & Hampton, I. (2001). An Overview of the Living Marine Resources of Namibia. *South African Journal of Marine Science, 23*, 5–35.

Clark, M. R., Rowden, A. A., Schlacher, T. A., Guinotte, J., Dunstan, P. K., Williams, A., O'Hara, T. D., Watling, L., Niklitschek, E., & Tsuchida, S. (2014). Identifying Ecologically or Biologically Significant Areas (EBSA): A Systematic Method and Its Application to Seamounts in the South Pacific Ocean. *Ocean & Coastal Management, 91*, 65–79.

Convention on Biological Diversity. (2011). *Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets: "Living in Harmony with Nature"*. Montreal, Canada: UNEP.

Desmet, P., & Cowling, R. (2004). Using the Species-Area Relationship to Set Baseline Targets for Conservation. *Ecology and Society, 9*, 11.

Dudley, N. (Ed.). (2008). *Guidelines for Applying Protected Area Management Categories*. Gland, Switzerland: IUCN.

Dunn, D. C., Ardron, J., Bax, N., Bernal, P., Cleary, J., Cresswell, I., Donnelly, B., Dunstan, P., Gjerde, K., Johnson, D., Kaschner, K., Lascelles, B., Rice, J., von Nordheim, H., Wood, L., & Halpin, P. N. (2014). The Convention on Biological Diversity's Ecologically or Biologically Significant Areas: Origins, Development, and Current Status. *Marine Policy, 49*, 137–145.

Dunstan, P. K., Bax, N. J., Dambacher, J. M., Hayes, K. R., Hedge, P. T., Smith, D. C., & Smith, A. D. M. (2016). Using Ecologically or Biologically Significant Marine Areas (EBSAs) to Implement Marine Spatial Planning. *Ocean & Coastal Management, 121*, 116–127.

Ehler, C., & Douvere, F. (2009). *Marine Spatial Planning: A Step-by Step Approach Towards Ecosystem-based Management*. Manual and Guides No 153 ICAM Dossier No 6. Paris: Intergovernmental Oceanographic Commission UNESCO IOC, 99 pp.

Gilliland, P. M., & Laffoley, D. (2008). Key Elements and Steps in the Process of Developing Ecosystem-Based Marine Spatial Planning. *Marine Policy, 32*, 787–796.

Halpern, B. S., Selkoe, K. A., Micheli, F., & Kappel, C. V. (2007). Evaluating and Ranking the Vulnerability of Global Marine Ecosystems to Anthropogenic Threats. *Conservation Biology, 21*, 1301–1315.

Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., Fox, H. E., Fujita, R., Heinemann, D., Lenihan, H. S., Madin, E. M. P., Perry, M. T., Selig, E. R., Spalding, M., Steneck, R., & Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science, 319*, 948–952.

Halpern, B. S., Frazier, M., Potapenko, J., Casey, K. S., Koenig, K., Longo, C., Lowndes, J. S., Rockwood, R. C., Selig, E. R., Selkoe, K. A., & Walbridge, S. (2015). Spatial and Temporal Changes in Cumulative Human Impacts on the World's Ocean. *Nature Communications, 6*, 7615.

Hamukuaya, H., Attwood, C., & Willemse, N. (2016). Transition to Ecosystem-Based Governance of the Benguela Current Large Marine Ecosystem. *Environmental Development, 17*, 310–321.

Harris, L., Holness, S., Nel, R., Lombard, A. T., & Schoeman, D. (2013). Intertidal Habitat Composition and Regional-Scale Shoreline Morphology Along the Benguela Coast. *Journal of Coastal Conservation, 17*, 143–154.

Harris, L., Nel, R., Holness, S., Sink, K., & Schoeman, D. (2014a). Setting Conservation Targets for Sandy Beach Ecosystems. *Estuarine, Coastal and Shelf Science, 150*(Part A), 45–57.

Harris, L. R., Watts, M. E., Nel, R., Schoeman, D. S., & Possingham, H. P. (2014b). Using Multivariate Statistics to Explore Trade-Offs Among Spatial Planning Scenarios. *Journal of Applied Ecology, 51*, 1504–1514.

Harris, L. R., Nel, R., Oosthuizen, H., Meÿer, M., Kotze, D., Anders, D., McCue, S., & Bachoo, S. (2018). Managing Conflicts Between Economic Activities and Threatened Migratory Marine Species Toward Creating a Multiobjective Blue Economy. *Conservation Biology, 32*, 411–423.

Heileman, S., & O'Toole, M. J. (2009). I West and Central Africa: I-1 Benguela Current LME. In K. Sherman & G. Hempel (Eds.), *The UNEP Large Marine Ecosystems Report: A Perspective on Changing Conditions in LMEs of the World's Regional Seas*. Nairobi, Kenya: United Nations Environment Programme.

Holness, S., Kirkman, S., Samaai, T., Wolf, T., Sink, K., Majiedt, P., Nsiangango, S., Kainge, P., Kilongo, K., Kathena, J., Harris, L. R., Lagabrielle, E., Kirchner, C., Chalmers, R., & Lombard, A. (2014). *Spatial Biodiversity Assessment and Spatial Management, Including Marine Protected Areas*. Final Report for the Benguela Current Commission Project BEH 09-01.

ICCAT. (2018). *International Commission for the Conservation of Atlantic Tunas Task II: Catch-Effort*. Madrid: ICCAT Retrieved from https://www.iccat.int/en/t2ce.asp.

Johnson, D. E., Barrio Froján, C., Turner, P. J., Weaver, P., Gunn, V., Dunn, D. C., Halpin, P., Bax, N. J., & Dunstan, P. K. (2018). Reviewing the EBSA Process: Improving on Success. *Marine Policy, 88*, 75–85.

Karenyi, N., Sink, K., & Nel, R. (2016). Defining Seascapes for Marine Unconsolidated Shelf Sediments in an Eastern Boundary Upwelling Region: The Southern Benguela as a Case Study. *Estuarine, Coastal and Shelf Science, 169*, 195–206.

Klein, C. J., Chan, A., Kircher, L., Cundiff, A. J., Gardner, N., Hrovat, Y., Scholz, A., Kendall, B. E., & Airame, S. (2008). Striking a Balance Between Biodiversity Conservation and Socioeconomic Viability in the Design of Marine Protected Areas. *Conservation Biology, 22*, 691–700.

Klein, C. J., Steinback, C., Watts, M., Scholz, A. J., & Possingham, H. P. (2009). Spatial Marine Zoning for Fisheries and Conservation. *Frontiers in Ecology and the Environment, 8*, 349–353.

Mace, G. M. (2014). Whose Conservation? *Science, 345*, 1558–1560.

Majiedt, P., Holness, S., Sink, K., Oosthuizen, A., & Chadwick, P. (2012). *Systematic Marine Biodiversity Plan for the West Coast of South Africa*. Cape Town, South Africa: South African National Biodiversity Institute.

Margules, C. R., & Pressey, R. L. (2000). Systematic Conservation Planning. *Nature, 405*, 243–253.

McLeod, K. L., Lubchenco, J., Palumbi, S. R., & Rosenberg, A. A. (2005). *Scientific Consensus Statement on Marine Ecosystem-Based Management*. Signed by 221 Academic Scientists and Policy Experts with Relevant Expertise and Published by the Communication Partnership for Science and the Sea. Retrieved from http://compassonline.org/?q=EBM.

Moilanen, A., Kujala, H., & Leathwick, J. R. (2009). The Zonation Framework and Software for Conservation Prioritization. In A. Moilanen, K. A. Wilson, & H. P. Possingham (Eds.), *Spatial Conservation Prioritization*. New York: Oxford University Press.

Pichegru, L., Ryan, P. G., Crawford, R. J. M., van der Lingen, C. D., & Grémillet, D. (2010). Behavioural Inertia Places a Top Marine Predator at Risk from Environmental Change in the Benguela Upwelling System. *Marine Biology, 157*, 537–544.

Pressey, R. L. (1994). Ad Hoc Reservations: Forward or Backward Steps in Developing Representative Reserve Systems? *Conservation Biology, 8*, 662–668.

Republic of South Africa. (2014). *Operation Phakisa*. Pretoria: RSA Retrieved November 2015, from http://www.operationphakisa.gov.za.

Republic of South Africa. (2016). National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003): Draft Notices and Regulations to Declare a Network of 22 New Proposed Marine Protected Areas. Government Gazette No. 10553. Volume 608, No. 39646, February 3.

Roberson, L. A., Lagabrielle, E., Lombard, A. T., Sink, K., Livingstone, T., Grantham, H., & Harris, J. M. (2017). Pelagic Bioregionalisation Using Open-Access Data for Better Planning of Marine Protected Area Networks. *Ocean & Coastal Management, 148*, 214–230.

Sala, E., Lubchenco, J., Grorud-Colvert, K., Novelli, C., Roberts, C., & Sumaila, U. R. (2018). Assessing Real Progress Towards Effective Ocean Protection. *Marine Policy, 91*, 11–13.

SANBI. (2017). *Technical Guidelines for CBD Maps: Guidelines for Developing a Map of Critical Biodiversity Areas and Ecological Support Areas Using Systematic Biodiversity Planning*. First Edition (Beta Version). Compiled by Driver, A., Holness, S. & Daniels, F. South African National Biodiversity Institute, Pretoria.

SANBI & UNEP-WCMC. (2016). *Mapping Biodiversity Priorities: A Practical, Science-Based Approach to National Biodiversity Assessment and Prioritisation to Inform Strategy and Action Planning*. Cambridge, UK: UNEP-WCMC.

Sink, K. J., Attwood, C. G., Lombard, A. T., Grantham, H., Leslie, R., Samaai, T., Kerwath, S., Majiedt, P., Fairweather, T., Hutchings, L., van der Lingen, C., Atkinson, L. J., Wilkinson, S., Holness, S., & Wolf, T. (2011). *Spatial Planning to Identify Focus Areas for Offshore Biodiversity Protection in South Africa. Final Report for the Offshore Marine Protected Area Project*. Cape Town: South African National Biodiversity Institute.

Sink, K., Holness, S., Harris, L., Majiedt, P., Atkinson, L., Robinson, T., Kirkman, S., Hutchings, L., Leslie, R., Lamberth, S., Kerwath, S., von der Heyden, S., Lombard, A., Attwood, C., Branch, G., Fairweather, T., Taljaard, S., Weerts, S., Cowley, P., Awad, A., Halpern, B., Grantham, H., & Wolf, T. (2012). *National Biodiversity Assessment 2011: Technical Report. Volume 4: Marine and Coastal Component*. Pretoria: South African National Biodiversity Institute.

Small, C., & Nicholls, R. J. (2003). A Global Analysis of Human Settlement in Coastal Zones. *Journal of Coastal Research, 19*, 584–599.

UN General Assembly. (2017). A/RES/72/249: International Legally Binding Instrument Under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction. Retrieved from http://www.un.org/depts/los/general_assembly/general_assembly_resolutions.htm.

UNEP-CBD. (2007). Report of the Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection. UNEP/CBD/EWS.MPA/1/2. Azores, Portugal, October 2–4.

UNEP-CBD. (2009). *Azores Scientific Criteria and Guidance for Identifying Ecologically or Biologically Significant Marine Areas and Designing Representative Networks of Marine Protected Areas in Open Ocean Waters and Deep Sea Habitats*. Montreal, Canada: Secretariat of the Convention on Biological Diversity.

White, C., Halpern, B. S., & Kappel, C. V. (2012). Ecosystem Service Tradeoff Analysis Reveals the Value of Marine Spatial Planning for Multiple Ocean Uses. *Proceedings of the National Academy of Sciences, 109*, 4696–4701.

Yesson, C., Clark, M. R., Taylor, M. L., & Rogers, A. D. (2011). The Global Distribution of Seamounts Based on 30 Arc Seconds Bathymetry Data. *Deep Sea Research Part I: Oceanographic Research Papers, 58*, 442–453.