

<https://doi.org/10.1038/s44183-025-00126-5>

What is an ecologically or biologically significant area?



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The first iteration of the ecologically or biologically significant areas (EBSA) process, which aims to ascribe ecological value to marine and coastal regions, has drawn to a close. This Convention on Biological Diversity process has collated vast amounts of information to describe 338 EBSAs that span from estuaries to ocean trenches. To increase the utility and accessibility of the ocean of knowledge generated by the EBSA process, and to support appropriate application of the dataset, clarity is required around the types of areas described, the biodiversity they hold, and the rationale for their selection. In this study, we provide a holistic answer to the question: What *is* an EBSA? We identify geographic and taxonomic gaps in EBSA descriptions, trends in the levels of protection observed, and ways forward to improve the uptake and appropriate use of the outputs of this singular intergovernmental process.

Ascribing values through the ecologically or biologically significant area (EBSA) process

Key societal goals to halt biodiversity loss and effectively conserve ecosystems are repeatedly articulated in international agreements and targets. Achievement of these goals requires monitoring and enhanced management of important environments—but which? How do we prioritise one seagrass bed over another, or a seagrass bed over a seamount? Societal preferences or, more specifically, the ‘assigned values’ we apply to things so that we can discuss their relative importance or worth¹, drive site selection in conservation as much as it does our selection of friends or restaurants. Many studies have attempted to use ‘assigned values’ to prioritise areas based on potential economic value², productivity³, ecosystem services⁴, importance for a taxonomic group (e.g., Important Bird & Biodiversity Areas or Important Marine Mammal Areas^{5,6}), or as wilderness^{7,8}. These are a diverse set of approaches, but all share one common feature: they were designed by experts (typically natural sciences experts), a group that tends to be non-representative by nationality, race, gender, and education. While appropriate and useful mechanisms to synthesise scientific knowledge, the approach limits the global acceptability and applicability of the priorities that they articulate—for example, not everyone cares about birds, and most do not understand ecosystem services.

Since 2011, the Secretariat of the Convention on Biological Diversity (CBD) has been coordinating regional workshops to facilitate the description of ecologically or biologically significant areas (EBSAs) in the global ocean—effectively, to ascribe agreed ecological value to certain marine and coastal areas⁹. In designing the process to describe EBSAs, the CBD had three distinct advantages over previous efforts to value places in the ocean. First, they had political buy-in: all stages of EBSA description (including the criteria applied) would be subject to review and critique by the 19688 Parties to the Convention. Second, it was defined as ‘a technical exercise’ to describe the biological and ecological components of an area. Consideration of anthropogenic stressors or management measures was outside the scope of the process. This dynamic reduced some of the potential biases from advocates and made it clear that no single sector was being targeted, as EBSAs were not described with a particular management goal in mind. Third, the process was designed to be participatory and to capture the current understanding of the participants. The CBD Secretariat was tasked with running consensus-based, regional workshops to describe areas that might meet the EBSA criteria. These workshops were chaired by regional representatives, and coastal Parties in the ocean basin region, relevant intergovernmental organisations, and nongovernmental observers were invited to attend and contribute. Workshop participants usually attended a

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Table 1 | CBD Recommendation IX/20 Annex I

Criteria	Definition	Rationale
Uniqueness or rarity	Area contains either: (i) unique ('the only one of its kind'), rare ('occurs only in few locations') or endemic species, populations or communities; and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features	• Irreplaceable • Loss would mean the probable permanent disappearance of diversity or a feature, or reduction of the diversity at any level.
Special importance for the life-history stages of species	Areas that are required for a population to survive and thrive.	Various biotic and abiotic conditions coupled with species-specific physiological constraints and preferences tend to make some parts of marine regions more suitable to particular life stages and functions than other parts.
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or an area with significant assemblages of such species.	To ensure the restoration and recovery of such species and habitats.
Vulnerability, Fragility, Sensitivity, or Slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.	The criteria indicate the degree of risk that will be incurred if human activities or natural events in the area or component cannot be managed effectively, or are pursued at an unsustainable rate.
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.	Important role in fuelling ecosystems and increasing the growth rates of organisms and their capacity for reproduction
Biological diversity	Area contains a comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.	Important for evolution and maintaining the resilience of marine species and ecosystems
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.	• To protect areas with near-natural structure, processes and functions • To maintain these areas as reference sites • To safeguard and enhance ecosystem resilience

Scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats.

short preparatory training event before they themselves described areas of interest (either before or during the workshop) and prepared the justification for each EBSA. Proposed EBSAs were then approved by all participants in a plenary session of the workshop, and finally submitted to the CBD for review and approval at the CBD Subsidiary Body for Scientific, Technical and Technological Advice and the Conference of Parties (see Dunn et al.⁹ for more information on this process). The EBSA process also benefited from the use of a suite of seven broad biodiversity criteria (Table 1)¹⁰. The criteria simplify a complex problem and can be applied with various levels of detail—as the quantity of data increases, the criteria can be used in more sophisticated ways (see, for instance, Dunstan et al.¹¹).

The first iteration of the EBSA process has drawn to a close. Over more than a decade, 15 regional workshops were convened involving >400 participants, covering 75.7% of the ocean, and identifying 338 EBSAs^{12–14}. Given the time constraints imposed on the development of the EBSA templates (they had to be completed within the timeframe of each workshop, usually 3–5 days), the sheer volume of information aggregated in the 15 final reports (3625 pages) is monumental. The outputs of the workshop are representative of (and limited to) the knowledge and views of the workshop participants. As such, the locations identified and the information in the EBSA descriptions also represent the availability of comparable region-wide data, and the capacity within each region to aggregate and synthesise local and regional data before the workshops¹². Previous studies have also highlighted the reluctance of parts of the scientific community to contribute data to the process^{12,13}. As scientific knowledge and access to data improve, new areas that meet the EBSA criteria will likely be identified, potentially requiring new workshops to formalise their status.

To date, the EBSA process is the only politically sanctioned, global effort to value places in the ocean. This has resulted in significant attention being paid to the output of the workshops and repeated attempts to include EBSAs in spatial planning^{15–17} and the design of monitoring programmes^{11,18}. Studies have most commonly taken the EBSAs as a whole, without regard to size, spatiotemporal dynamism or the habitats and species included in EBSA templates (e.g., Gownaris et al.¹⁹; Visalli et al.¹⁵). Other studies (e.g., Harris et al.¹⁶) focus solely on smaller EBSAs within national jurisdictions, and suggest that 'very large EBSAs with boundaries that are not linked to finer scale biodiversity features ... are less helpful in a MSP context'. This is a

reasonable approach to limiting variability within the EBSA dataset, but one quarter of EBSAs ($n = 86$) are larger than 100,000 km². To increase the utility and accessibility of the ocean of knowledge generated by this singular intergovernmental process, and to support appropriate application of the dataset, clarity is required around the types of areas described, the biodiversity they hold, and the rationale for their selection. Here, we attempt to (1) better illuminate the ecosystems and species driving EBSA descriptions, (2) identify gaps across workshop and biogeographic boundaries, (3) update classifications that can help determine if and how EBSA information should be used in a particular management context, and (4) understand the degree to which the values ascribed to these places were being protected through enhanced management measures (as called for by the CBD) when they were described. By categorising and synthesising the information contained within the EBSA templates, we seek to provide a holistic answer to the question: What is an EBSA?

What is an EBSA?

While it is fairly easy to describe the process that has generated 338 EBSAs in the ocean⁹, it is a lot harder to articulate what an EBSA is—because they encompass a huge amount of heterogeneity (Fig. 1). The same aspects of the process that give the results political cachet and ease of applicability, have also resulted in tremendous variability in the sites that are now collectively described as EBSAs. The broad suite of criteria and the fact that only one criterion had to necessarily be met allowed for areas to be identified that represented everything from individual habitat patches to ephemeral or dynamic oceanographic processes that span ocean basins. Although guided by common technical teams, the wide range of participant expertise in the meetings and the time constraints resulted in individuals interpreting the appropriate degree of aggregation of information differently; in some cases again identifying individual patches of a specific habitat (e.g., Guaymas Basin Hydrothermal Vents Sanctuary), while in other cases combining multiple habitats and/or oceanographic processes in broader descriptions of large areas (e.g., the Namaqua Coastal Area EBSA in South Africa). Some descriptions identify only pelagic features, others only benthic, yet others cover both or are non-specific. Finally, there were a multitude of possible rationales for describing particular areas as being important, and they are not always easily ascertained.

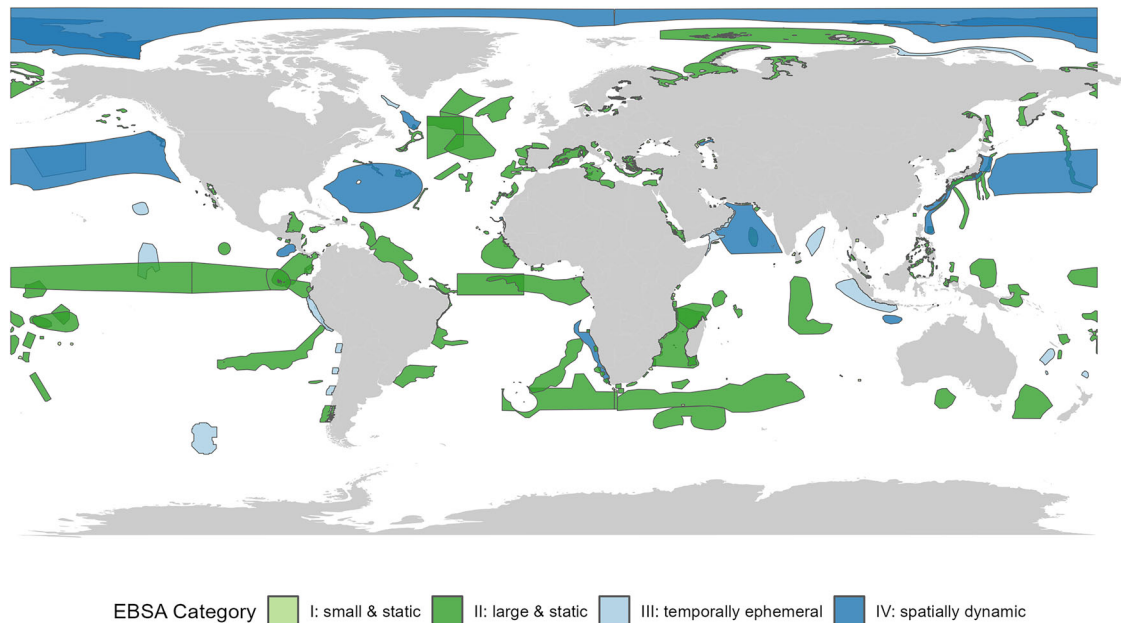


Fig. 1 | The 336 spatially delineated EBSAs (out of 338) described across 15 regional workshops. The EBSAs are coloured by spatial and temporal classification. We build on the EBSA classification in Johnson et al.¹³, but use size rather

than the number of parts of an EBSA to differentiate static EBSAs. Category I EBSAs (i.e. small and static EBSAs) are generally too small and coastal to be seen at a global scale.

So, what types of habitats were identified, and why were they identified as important? Ascribing intent is an admittedly subjective task, as there was no specific part of the EBSA template that required a statement of specific intent. Regardless, it is possible to get a sense of the rationale offered in each template. To derive intent, twelve reviewers read individual EBSA templates and ascribed characteristics to them in a standardised datasheet, including information on the primary ecosystem type described and whether there was a primary taxonomic group identified (Appendix S1). Altogether, coastal habitats account for just over half ($n = 184$) of the EBSAs identified in the first round of workshops. Most of those EBSAs ($n = 140$) broadly described coastal ecosystems, combining specific coastal ecosystems together in three classes we described as coastal seas, bays, lagoons and gulfs; islands and atolls; and coastal zones (Fig. 2). This aggregation of coastal habitats within a single EBSA description by workshop participants resulted in fewer EBSAs focused on specific coastal ecosystems: less than 10% of EBSAs described only one coastal habitat (e.g., mangroves, coral reefs, or macroalgal beds; $n = 24$). A further 6% fall in between and identify a limited set of habitats associated with wetlands, estuaries, and river deltas ($n = 20$).

The other half of the EBSAs are divided between the open-ocean ($n = 58$; 17%) and the deep-sea ($n = 94$; 28%). EBSAs identified in open-ocean areas were predominantly areas of high productivity (e.g., upwellings or thermal domes) or oceanographic features (e.g., convergence zones, convection zones or currents). Deep-sea EBSAs were focused largely on continental shelf features, and ridges and seamounts.

Along with understanding what types of habitats underpinned EBSA templates, consumers of EBSA information frequently seek to understand the value placed on taxonomic groups or species by the EBSA process. Since two of the seven criteria applied by EBSA workshop participants to describe EBSAs relate solely to the conservation status and life stages of species, it makes sense to interrogate their role in the process. Areas of importance for different life-history stages of megavertebrate species (e.g., foraging, reproductive activity, or migration) were found in more than 80% of all EBSA descriptions, while 26% of EBSAs ($n = 87$) were described solely due to the importance of a site to one or more species. The most frequent taxonomic group used to identify these single rationale EBSAs was birds ($n = 22$), followed by bony and cartilaginous fish ($n = 18$), sea turtles ($n = 12$) and marine mammals ($n = 11$); multi-taxa hotspots accounted for the remainder ($n = 24$). Interestingly, while only 7% of EBSAs identified birds as the

primary rationale for their delineation (or 14% if we include multi-taxa rationales), 28% of all EBSAs mentioned the presence of an Important Bird or Biodiversity Area² in the EBSA template. This is indicative of the degree to which coastal EBSAs frequently combine multiple habitats and rationales within a single EBSA description, as well as the massive effort of Birdlife International to support and inform the delineation of EBSAs in the regional workshops with highly quantified and standardised information.

EBSA classifications

Johnson et al.¹³ describe a classification scheme for EBSAs which placed them in one of four categories: (i) individual, spatially stable features; (ii) grouped, spatially stable features; (iii) spatially stable features whose individual positions are not known; (iv) dynamic features. In closely reviewing the information in the EBSA templates, we find that understanding what constitutes ‘grouping’ is not an easy task. The purpose of classifying EBSAs for this study was to provide clearer information to potential users of the EBSA information for the purpose of developing monitoring or management measures. The operative characteristic for whether a single management measure might be applied to an EBSA is not whether it is grouped (lots of MPAs contain various habitat types), but the size of the area. As such, we redefine categories (i) and (ii) to be static features below or above a threshold size. While there has been a trend toward very large MPAs over the last decade, most management measures operate more on the scale of 1000 s of km² (see, for instance, Dunn et al.²⁰). Here, we apply a threshold of 10,000 km². To differentiate static features that might be addressed as a single unit in a management context from features that will likely require a variety of approaches to monitor and manage. The threshold is not arbitrary, but is highly flexible and represents a guideline. Thus, our four categories are: (i) small (<10,000 km²), spatially stable features; (ii) large (>10,000 km²), spatially stable features; (iii) spatially stable and temporally ephemeral features (where the characteristics of the area that make it an EBSA are not always present; hereafter, ‘ephemeral EBSAs’); (iv) spatially dynamic and temporally persistent features (where the characteristics that make it an EBSA shift spatially; hereafter, ‘dynamic EBSAs’).

EBSAs can also be classified by the jurisdiction(s) they cover: those that (a) fall into a single national jurisdiction, (b) cross national jurisdictions, (c) straddle national jurisdictions and areas beyond national jurisdiction (ABNJ), or (d) fall entirely in ABNJ. To do this, we ran a multi-step

Fig. 2 | What's in an EBSA? All 336 spatially delineated EBSAs (two had no boundaries and were removed from the analysis) were categorised by the main ecosystem described, and grouped broadly into three categories: coastal ecosystems, open-ocean ecosystems, and deep-sea ecosystems. EBSA descriptions frequently contained information about more than one ecosystem, making assignment to one category or another difficult. Lighter shades represent ecosystems that were deemed to be the primary purpose of the EBSA description, while darker shades represent those in which the EBSA occurred but were not necessarily the focus of the description.

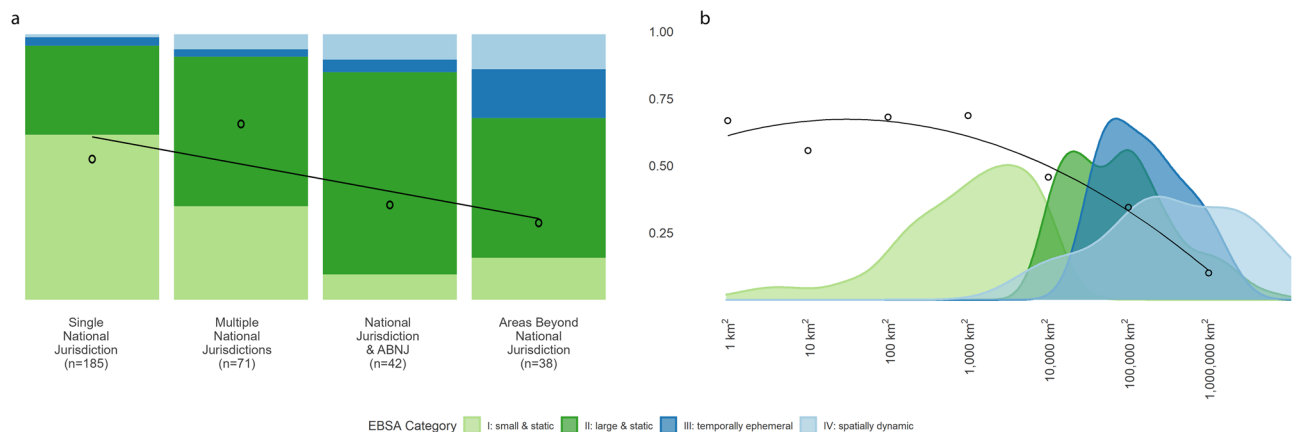
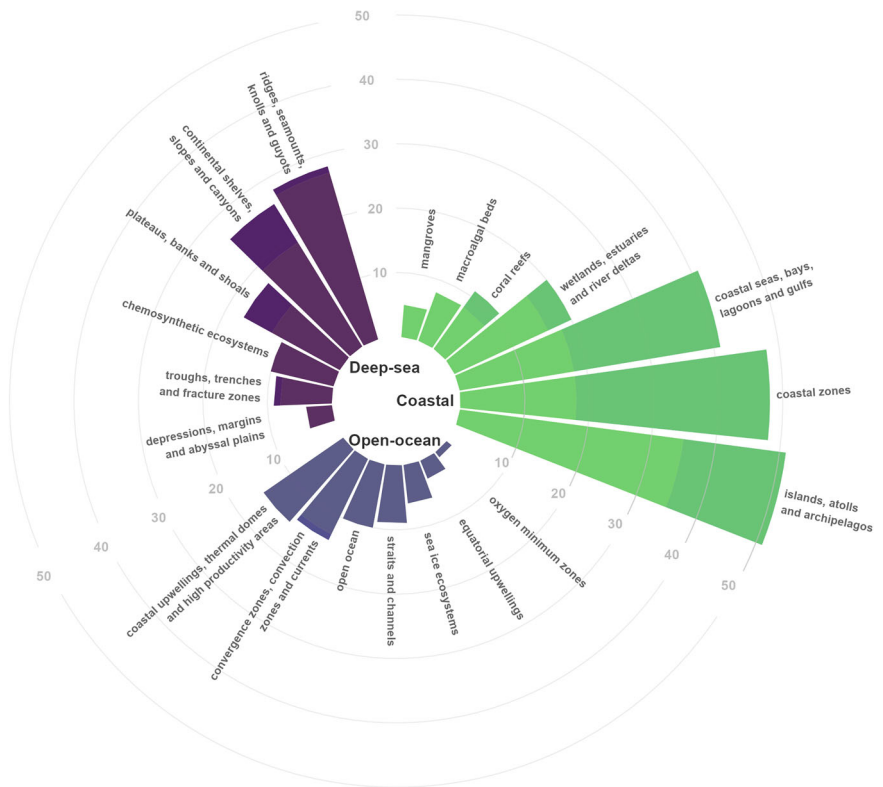


Fig. 3 | EBSAs by classification, jurisdiction, and size. The proportion of EBSAs by EBSA category and jurisdiction (a), or size (b). Black open circles reflect the proportion of EBSA templates that mention enhanced management measures in each category or size class with linear (a) and polynomial (b) black trend lines.

geoprocessing model that intersected EBSA geographic boundaries with ABNJ areas and global Exclusive Economic Zones (EEZs). The resulting parts of EBSAs were summarised by EBSA ID to quantify the amount of each national jurisdiction and ABNJ overlapped by each EBSA (Supplementary Table 1). While the EBSA process prior to COP10 was focused on ascribing ecological values to ABNJ⁹, the vast majority of EBSAs (76%) fall under one or more national jurisdictions. *EBSAs are dominated by small, static areas within one or more national jurisdictions.* The number of small, static EBSAs decreases as they become transboundary and include more ABNJ (Fig. 3a), while EBSA size (Fig. 3b) and the number of ephemeral or dynamic EBSAs increase. When we combine the spatiotemporal and jurisdictional characteristics (Fig. 3), we see a clear pattern of smaller, more static EBSAs within national jurisdictions and larger, more ephemeral or dynamic EBSAs in ABNJ. The proportion of EBSA templates that mention enhanced management measures (black open circles and trend line) decreases as EBSAs move more into ABNJ, as they get bigger, and as they are

more dynamic (Type I = 66%, Type II = 45%, Type III = 6%, Type IV = 7%). The combination of these characteristics helps to define what type of enhanced management is possible and the level of cooperation needed for governance of EBSAs. How enhanced management was determined is described below in the section on 'Ecologically or biologically significant areas in need of protection', and encompasses a wide range of measures and designations.

What was missed?

EBSAs have been described across much of the ocean, but due to constraints on time (each workshop was only 1 week), personnel (contributions to EBSA templates were largely limited to the few dozen people at each workshop), and data availability (either because they were not provided or, more frequently, because they did not exist), some EBSAs may have been missed. Identifying these gaps is challenging, but consideration of which ecosystems were described in EBSAs by regional workshop, and overall

biogeographic coverage can inform our understanding of potential gaps (See Johnson et al.¹³ for a broader discussion of why areas were not selected as EBSAs). To understand overlap with biogeographic regions, we applied the same approach as was done with national jurisdictions, except the parts (and numbers of overlapping EBSAs) were summarised by biogeographic province. Specifically, we used the Global Open Oceans and Deep Seabed (GOODS) Benthic Provinces^{21,22}, and the Longhurst Pelagic Provinces²³ (Supplementary Table 1). Looking across three broad ecosystem categories (coastal, open-ocean, and deep-sea ecosystems), deep-sea ecosystems were poorly represented in one third of workshops (Supplementary Fig. 1). Given that the Baltic Sea has a maximum depth of about 300 m, it is understandable that only two deep-sea EBSAs were identified in the region. However, the Arctic, Black & Caspian Seas, Northeast Indian Ocean, and Northwest Indian Ocean have no similar justification for the limited number of deep-sea EBSAs identified. Looking up in the water column, the Baltic, Black & Caspian Seas, Northeast Atlantic, Northwest Atlantic, Mediterranean and Wider Caribbean regions all have very limited numbers of pelagic ecosystems identified as EBSAs. This lack of deep-sea or pelagic EBSAs is likely due to lack of data, lack of deep-sea expertise at the workshops, and discomfort on the part of certain countries with identifying mineral-rich benthic areas as EBSAs.

As previously mentioned, coastal systems were frequently aggregated in EBSA descriptions, making it hard to determine the ecological focus of the template (Fig. S2). Ecosystems and species have different levels of vulnerability to various stressors, so being able to identify the type of ecosystem/species and its distribution within an area are critical elements in developing management measures, including monitoring programmes. Thus, another type of gap is in the specificity of the EBSA: the larger and more general an EBSA, the more analysis is required to identify the ecological components of the area and their management needs. Lack of specific information on habitats and species within EBSAs also makes them harder to use within spatial planning frameworks or when quantifying progress toward societal goals. All coastal EBSAs in the Northeast Atlantic, Baltic, Mediterranean, Northeast Indian Ocean and South Pacific were aggregates of multiple coastal systems. Further differentiation and delineation of those EBSAs would likely be necessary before management measures could be considered (see e.g., Harris et al.¹⁶). This would also likely increase the number of mangrove-specific EBSAs, which are notably missing from the Eastern Tropical & Temperate Pacific, the Southern Indian Ocean, and the Wider Caribbean & Central Atlantic. Macroalgal diversity on an ocean basin scale has been recently noted to be highest in the North Atlantic and North Pacific Oceans^{24,25}, yet among the regional workshops in these ocean basins, there is only one EBSA focused specifically on macroalgal ecosystems. In this case, however, the gap is not solely one of omission, but one based on non-participation: the United States and Canada opted not to include their EEZs in the EBSA process, indicating that they had internal processes underway.

As indicated above, a final way to interrogate the EBSA dataset to understand gaps is to examine biogeographic coverage. Looking at Longhurst Provinces²³, some of the most biodiverse regions in the world appear underrepresented (Table S3). The Sunda-Arafura Shelves Province and Archipelagic Deep Basins Province largely cover the most biodiverse marine region in the world²⁶, but only have 7% of the area covered by EBSAs. With similarly high levels of biodiversity, the <0.3% coverage of the China Sea Coastal Province and the East India Coastal Province would also seem to represent obvious gaps. Of the 19 Longhurst provinces with <10% coverage, many have EEZs that were excluded from the EBSA process by the country (e.g., Alaska Downwelling Coastal Province, East Australian Coastal Province, New Zealand Coastal Province, NE Atlantic Shelves Province), or included areas where no EBSA workshop was undertaken (e.g., Antarctic Province, Austral Polar Province, Subantarctic Province, SW Atlantic Shelves Province). Overlays with benthic biogeographic classifications show similar gaps (Tables S4 and S5), but more for abyssal regions than bathyal provinces. Specifically, only one GOODS bathyal province²¹ had less than 10% coverage by EBSAs (Northern North Pacific Province),

while more abyssal provinces show lower levels of coverage including the West Pacific Basins (0.6%), Brazil Basin (3%), and the Argentine Basin and South Pacific provinces (5%).

Ecologically or biologically significant areas in need of protection

A common misinterpretation of EBSAs is that the designation itself carries some specific protection measures¹³. The EBSA process is a scientific and technical exercise⁹, and the output (i.e. the EBSAs themselves) does not carry direct management implications. However, through COP 11, EBSAs were always described in CBD recommendations as ‘ecologically or biologically significant areas *in need of protection*’ [emphasis added]. As far back as 2005, the intent of identifying these areas was reported to be ‘on those grounds [they] would particularly benefit from more risk-averse than ‘normal’ management and protection’²⁷. This does not assume EBSAs, in whole or in part, should become no-take marine reserves. It simply (and intuitively) implies that, if an area is ascribed heightened value by society (through an internationally agreed process involving 188 countries), some level of enhanced management (including through increased monitoring) should be applied so that we understand and can address anthropogenic impacts on those areas. Which leads to the logical questions: to what degree are EBSAs protected, from what, and by what means?

To understand levels of enhanced management, we reviewed EBSA templates for any mention of enhanced management measures or designations by intergovernmental organisations. We defined enhanced management as any mention of nationally or regionally (e.g., via HELCOM or OSPAR) designated MPAs, fisheries closures (including areas designated as Vulnerable Marine Ecosystem by regional fisheries management organisations) within the EBSA template. Regional designations, including SPAMIs (Special Areas of Mediterranean Interest) and Natura 2000 sites, as well as intergovernmental designations such as UNESCO World Heritage Sites and Biosphere Reserves, and RAMSAR sites were also included. Although the specific mechanism for enhanced management of such areas is not included in the designations, these areas frequently receive greater consideration in permitting processes and frequently do have national-level management measures. Clearly, it is possible, and was the case, that an area covered by an EBSA contained a management measure that was not mentioned in the template. As such, this is a minimum estimate of existing enhanced management, but it can provide a general sense of the relative level of enhanced management in EBSAs. Conversely, mention of a management measure did not imply that the entire EBSA (or even a significant part of the EBSA) fell under that management regime. Thus, while it is a minimum estimate of overlap with management measures, it does not imply that these measures provided adequate management of the biodiversity in the EBSA.

While half (51%) of EBSA templates mentioned the presence of some type of enhanced management, there were large differences across ecosystems and regions (Figs. S3 and S4), and in the type of management measure (Table S2). The most common management measures mentioned were national biodiversity protection measures such as protected areas, reserves or national parks (39%), followed by Ramsar sites (12%), UNESCO designations (9%), and national or local fisheries closures (8%). Enhanced management measures were infrequently mentioned in EBSAs located in open-ocean ecosystems (mean = 30.7%, sd = 20.0) and the three Pacific regions (mean = 27.9%, sd = 12.9). Conversely, coastal ecosystems (mean = 68.6%, sd = 14.6), and inland and coastal sea regions (i.e. the Baltic, Black & Caspian, Mediterranean, and the Seas of East Asia) (mean = 78.4%, sd = 14.5) cited the greatest proportion of enhanced management measures. Reflecting the dearth of comprehensive protection measures in ABNJ, approximately a quarter of EBSAs that were entirely in ABNJ cited some type of fisheries measure (27%), but only 7% cited the existence of an MPA. Similarly, ephemeral and dynamic EBSAs very rarely mention any type of enhanced management measure (6% each). Interestingly, EBSAs that were more obviously delineated for a specific species (or group of species) did not mention enhanced management measures more than the overall suite of EBSAs (mean = 52.1%, sd = 14.5). Overall, there is a trend toward less

inclusion of enhanced management measures (and likely less enhanced management) as EBSAs include more ABNJ, get bigger, and increase in dynamism (Fig. 3). These trends also reflect a tendency across workshops for some countries to put forward areas that had previously been designated coastal MPAs as EBSAs. So, while EBSAs are not MPAs, MPAs are sometimes EBSAs.

Enabling enhanced management

The road to many degraded ecosystems is littered with national, semi-governmental and intergovernmental designations that lack specific or adequate management measures. It is one thing to ascribe value to a location and draw attention to it, and quite another to convince regulatory authorities to implement meaningful measures to assure the long-term persistence of that value and budgeting to fund its management, including basic levels of monitoring to understand what value exists or has been lost. Has the EBSA designation resulted in improved management for half of the EBSAs that did not report any enhanced management measures prior to their designation? While no comprehensive answer is yet available, there is clear evidence that the information and capacity generated or supported by the EBSA process have resulted in enhanced management of many EBSAs. International recognition is important to stimulate and support national management initiatives, especially in countries with limited scientific capacity. One example of this follows the designation of EBSAs by the South-east Atlantic workshop, where work has been undertaken at both a national level and under the Benguela Current Marine Spatial Management and Governance Project (MARISMA, 2014–2022) of the Benguela Current Large Marine Ecosystem programme. The MARISMA project analysed 17 EBSAs in member country EEZs (Angola, Namibia and South Africa), improving delineations and generating 10 new prospective EBSAs that are being integrated into national marine spatial plans¹⁶. South Africa has taken the process the furthest, implementing 20 new MPAs that all overlap EBSAs²⁸.

The EBSA process has also had (and will continue to have) a strong influence on the application of enhanced management in ABNJ. From the earliest days of the EBSA process, there has been a focus on the open ocean and deep seas⁹. The regional workshop process established at COP10 was specifically designed to generate and convey information to intergovernmental organisations, especially the United Nations General Assembly, to inform their deliberations over a new treaty for the conservation and sustainable use of marine biological diversity in ABNJ (i.e. the BBNJ Treaty). Through that mechanism, the outputs from the process informed and pushed the Ad-hoc Working Group (2004–2015), the Preparatory Committee (2016–2017), and the Intergovernmental Conference (2018–2023). One direct result was the inclusion of the EBSA criteria in the indicative list of criteria used in the BBNJ treaty text²⁹. Other organisations have also noted and used EBSA information, including the Convention on Migratory Species³⁰, and the Northwest Atlantic Fisheries Organisation, which in 2019 updated boundaries of a Vulnerable Marine Ecosystem closure in alignment with an EBSA delineated for the same seamounts^{31,32}.

As mentioned, over a quarter of EBSAs are larger than 100,000 km². Multiple studies have already suggested that an area of that size is large enough to warrant its own planning process, similar to what was undertaken by South Africa and through the MARISMA project^{9,33}. For example, extensive work has been done looking at biodiversity and stressors in the Sargasso Sea EBSA, with the intent to identify a suite of management actions that could be applied to manage this >400,000 km² region³⁴. With the recent adoption of the BBNJ treaty, developing spatial planning frameworks for how to holistically govern these critical, albeit large, EBSAs is timely and relevant³⁵.

Recommendations and a path forward for the EBSA process

The success of the EBSA process points to a different way to ascribe ecological value to guide and prioritise the development of monitoring and management measures. It is a process that is supported by scientific

expertise but not driven by scientific experts. As a process equally accessible to people of different backgrounds and experiences, it highlights an important role for scientists in facilitating social processes using their knowledge. Time will tell how long the EBSA exercise informs international marine planning and associated negotiations, but the 16th Conference of the Parties provided modalities for the modification of EBSA descriptions and paved the way for new EBSA descriptions to be submitted—delivering a way forward for the EBSA process to continue after years of debate. Beyond the CBD, it is clear that the capacity to meaningfully engage in discussions about valuing and delineating marine biodiversity and habitats that has been built through the EBSA workshops will remain for a long time and should support national and regional processes and management.

Given the results of this study, we recommend that thematic meetings be supported through the CBD to look at specific regions and habitats. Despite the existence of large EBSAs describing areas of high productivity that cover vast parts of the High Seas, ABNJ are a clear gap and in need of a directed effort to describe further EBSAs. These can inform priorities for the development of strategic environmental assessments or area-based management tools under the new BBNJ Treaty for large EBSAs in ABNJ, or support the development of smaller-scale management measures. The biogeographic gaps identified in this study also warrant further attention. While seabirds were very well represented during the EBSA workshops, much work has been done on expanding the information available to support description of areas of importance to marine mammals and sharks and rays. A thematic workshop on these taxonomic groups would quickly fill gaps identified in the first iteration of the EBSA process. Finally, the EBSA criteria are site-based criteria that support ascription of ecological value in a relatively standardised manner. The same decision by the CBD has a companion appendix focused on network criteria, of which EBSAs are the first criterion (CBD Decision IX/20 Appendix 2). Now that a first iteration of the EBSA description has been completed, an expert workshop focused on how EBSAs fit within the context of the other network criteria (including representativity, replication, connectivity, and viability and adequacy) would be useful in guiding spatial planning, particularly in ABNJ. Such an exercise would be highly relevant to Targets 1 (spatial planning), 2 (restoration) and 3 ('30 × 30') of the Kunming-Montreal Global Biodiversity Framework and the Life Under Water goal (14) of the Sustainable Development Goals.

The EBSA process has synthesised an incredible amount of information, but use of that information has been limited by the lack of an easy mechanism to understand which areas are relevant for end users. We hope this study and the accompanying dataset (Appendix A) will provide an avenue to increase the use of the information contained in the EBSA templates. We urge management organisations, intergovernmental organisations, academics, civil society, and industry to take a more nuanced approach to the use of EBSAs—to recognise that EBSAs aren't a singular thing. They describe areas across vast spatial scales, temporal stability, ocean depths, ecological aggregation, and the level of management. Only by being transparent about the diversity of EBSAs can we help ensure their uptake and correct use, and determine the necessary monitoring and management they may require.

Society has gone to great lengths to better understand (i.e. collect, analyse and synthesise scientific data and other ways of knowing), and thus to be able to ascribe value to these places as 'ecologically and biologically significant areas'. The EBSA process has shown what can be achieved through goodwill, collaboration and direct engagement between interested scientists, Parties and observers, operating within negotiated and agreed guidelines. It has also highlighted the benefits and constraints of a broadly defined consensus process to generate and disseminate management-ready information. With no other mechanism for countries to agree and jointly ascribe ecological value to places in the ocean, it is imperative that we make the most of the information collated in the EBSA process and that we strive to ensure the process continues. We have aggregated an ocean of knowledge in the EBSA process, but, as with our global ocean, the vast majority remains to be understood and adequately protected.

Data availability

All EBSA templates used in the literature review and the shapefiles for each EBSA are freely available through the Convention on Biological Diversity EBSA website (<http://www.cbd.int/ebsa>). The EEZ layer used in the analysis and the Longhurst Pelagic Provinces were downloaded from the Flanders Marine Institute's Marine Regions data centre (<https://www.marineregions.org/eez.php>). The EEZ layer represents global EEZs merged with land, which help address issues with the use of different shorelines in each EBSA workshop. The results of the review of EBSA templates (i.e. the data used in the analysis) are available in the Supplementary Information. The code used to generate the figures is available upon request.

Received: 3 June 2024; Accepted: 28 April 2025;

Published online: 31 May 2025

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Acknowledgements

This work could have only taken place through engagement with the Secretariat of the Convention on Biological Diversity (SCBD), and under the auspice of the Global Ocean Biodiversity Initiative (GOBI). We are incredibly thankful to both the SCBD and GOBI for the opportunity. Primary support was from the GOBI grant from the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag.

Author contributions

D.D., V.K., D.J. and P.H. conceived of the review. D.D., J.C., S.D., N.B., C.C., B.D., P.D., E.K. and P.H. participated in the EBSA process. All of those

authors and C.K., G.C. and D.N. participated in the review of literature (EBSA templates) except V.G. and D.J.. D.D., S.D., J.C., L.B. and P.D. wrote the main text of the manuscript. D.D., D.N., and L.B. conceptualised and prepared all figures. All authors reviewed and edited the manuscript.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1038/s44183-025-00126-5>.

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