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EXPERT WORKSHOP TO IDENTIFY OPTIONS
FOR MODIFYING THE DESCRIPTION OF
ECOLOGICALLY OR BIOLOGICALLY
SIGNIFICANT MARINE AREAS AND
DESCRIBING NEW AREAS
Brussels, 3-5 February 2020

A GAP ANALYSIS REVIEW OF ECOLOGICALLY OR BIOLOGICALLYSIGNIFICANT MARINE AREAS

Note by the Executive Secretary

1. The Executive Secretary is circulating herewith for the information of participants in the Expert Workshop to Identify Options for Modifying the Description of Ecologically or Biologically Significant Marine Areas (EBSAs) and Describing New Areas, a background document providing a gap analysis review of ecologically or biologically significant marine areas. The document was prepared by the Marine Geospatial Ecology Lab of Duke University, in collaboration with the Global Ocean Biodiversity Initiative, with financial support from the European Union and the Government of Sweden.

2. The present document was prepared in April 2019 and reflects only information on ecologically or biologically significant marine areas that have been considered by the Subsidiary Body on Scientific, Technical and Technological Advice and the Conference of the Parties to the Convention on Biological Diversity as of 2019.

3. The document is being provided as contextual information for the workshop participants, but it is not anticipated that this document will be discussed in detail during the workshop.

4. The document is being circulated in the form and language in which it was received by the Secretariat.

A REVIEW OF ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT AREAS (EBSAS)

Report prepared for:
The Secretariat of the Convention on Biological Diversity (CBD)
Global Ocean Biodiversity Initiative (GOBI)

Prepared by:
Marine Geospatial Ecology Lab, Duke University
April 2019

This review was commissioned by the Secretariat of the Convention on Biological Diversity (CBD), and organized by the Global Ocean Biodiversity Initiative (GOBI). It was prepared for GOBI by the Marine Geospatial Ecology Lab at Duke University (http://mgel.env.duke.edu).

The geographic designations referred to in this report do not imply the expressions of any opinion whatsoever on the part of GOBI or the Secretariat of the Convention on Biological Diversity concerning the legal status of any country, territory or area, or area of its authorities, or concerning the delineation of its frontiers or boundaries.

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We would like to acknowledge the numerous data providers and projects that helped with this assessment. We also are grateful to the many participants involved in the CBD EBSA process and those who contributed their time, data, and expertise on marine migratory species.

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Table of Contents

Table of Figures

Abstract

Since 2011, the Secretariat of the Convention on Biological Diversity has been coordinating regional workshops to facilitate the description of Ecologically or Biologically Significant Marine Areas (EBSAs) in the global ocean. Fourteen regional workshops have been conducted and 321 EBSAs have been described to date. Recent discussions under the CBD regarding have addressed the need for a review of the status and coverage of the existing collection of EBSAs as beneficial for the identification of potential gaps in coverage or areas in need of further attention in future EBSA work. This review assesses the coverage of the global EBSA collection according to various factors to help identify potential gaps and trends. This review is based on two approaches: (1) mapping overlays of the existing EBSAs on jurisdictional areas, biogeographic features, habitats and enhanced management status; and (2) a review of each of the EBSA descriptions to characterize type of EBSA, the criteria described, the primary taxonomic features described, the role of endemic species and the role of connectivity used in the individual EBSA description. The review identifies a number of trends and patterns of coverage globally as well as differences between workshop regions and individual EBSA descriptions. This assessment should be directly useful to inform the interpretation of the existing EBSAs as well as the planning of future EBSA workshops or regional EBSA review processes.

Introduction

Ecologically or Biologically Significant Marine Areas are geographically discrete areas that provide important services to one or more species/populations of an ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet the criteria as identified in Annex I of Decision IX/20. Fourteen regional scientific expert workshops have been conducted between 2011 to 2018 and have described 321 EBSAs[1]. The EBSA description process is continuing with additional regional workshops being planned and/or under consideration. As well, the need to review and revisit previously covered regions is now being considered.

In December 2017, an expert workshop to develop options for reviewing and modifying the description of areas meeting the criteria for ecologically or biologically significant marine areas (EBSAs) met to provide guidance on the next steps for the EBSA process. One of the outcomes of this workshop was the call to conduct a review of the current collection of EBSAs to allow for a more objective evaluation of the geographic, taxonomic, type and status coverage of EBSA areas to date.

At a CBD expert workshop in Berlin, Germany in 2017, a number of potential reasons that individual EBSAs or regions may need to be considered for review were discussed, including, for example the fact that new data has become available and spatial or taxonomic gaps have been identified

There have generally been two types of scientific input into CBD regional EBSA workshops: (1) Regional expert knowledge documented in EBSA description submissions, and (2) general environmental and biological data aggregated during the workshop preparations. A recent review (Johnson *et al.* 2018) provided a matrix describing the relationship of data availability and the commission or omission of an EBSA description. The matrix highlighted decisions where: (1) data was available and an EBSA area was described; (2) data was available and an EBSA was not described; (3) data was not available and an EBSA was described; and (4) data was not available and an EBSA was not described. This matrix helps identify where and how new data acquisitions can help to address gaps in EBSA descriptions.

It's important that linkages are made with mechanisms that can provide access to new data, including in the context of existing EBSAs, as well as future efforts to describe EBSAs. The OBIS information system, a program of UNESCO-IOC/IODE is an example of an international, open-access information system that is available to support the EBSA process. A new tool developed for the OBIS information system web interface now allows for data queries to be conducted for all biological data contained within existing EBSA areas. This type of specialized data tool will be important for continued review and assessment of EBSAs. In addition to new data coming on-line, new 3-dimensional biogeographic frameworks have also recently become available. The new Ecological Marine Units approach (Sayre et al. 2017) and a new mesopelagic biogeography (Sutton et al. 2017) illustrate these emerging approaches.

There has also been discussion on the value of classifying EBSAs according to a general typology to add precision to the interpretation of EBSAs. The general EBSA types include: (1) static/fixed features; (2) multiple (grouped) static/fixed features; (3) ephemeral features; and (4) dynamic features. This post-hoc classification has been suggested to add precision to their description and also aid monitoring.

[1] See Dunn et al., 2014 for a broader review of the historical development of the EBSA criteria and regional workshop process.

Another important potential reason for revisiting EBSA descriptions is the uneven spatial and thematic coverage of the EBSA workshops or EBSA descriptions. Spatial issues include: (1) areas that were excluded from consideration because Parties were conducting national EBSA processes, (2) regions that have not had a workshop conducted to date; and (3) areas that have a workshop scheduled for the future. In addition, there is potential for low rates of EBSA description in regions of sparse data.

Another issue raised in the context of scientific needs for review of the EBSA process concerns the fact that a number of EBSAs were described more than five years ago. It has been suggested that EBSAs should be reviewed periodically to ensure that the data and descriptions are up-to-date and reflect the current understanding of the regions. It was also noted that some ecosystems, such as the EBSAs focused on Arctic sea ice, could require more frequent review due to rapid change in those regions. This recommendation is particularly relevant given the rapid pace of technological development in ocean observing, resulting in large amounts of data and new knowledge systems that provide easier access and capacity to interpret the information being generated (e.g. the results the Global Ocean Biodiversity Initiative's recent work supported by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU); Johnson *et al.* 2019). Thematic reviews on topics such as migratory species and deep-sea ecosystems could also be a fruitful approach for the review and updating of EBSA descriptions. One of the GOBI-IKI projects, the Migratory Connectivity in the Ocean (MiCO; mico.eco) system, is an example of such a program that can serve to inform future efforts under the EBSA process, as well as the use of current EBSA information to support planning and management.

This report describes an initial review of the geographic, taxonomic, and EBSA typological coverage of the global EBSA collection to help begin to address some of the issues outlined above. This initial review is based on two approaches: (1) mapping overlays of the existing EBSA areas on jurisdictional areas, biogeographic features, habitats and enhanced management status; and (2) a review of each of the EBSA descriptions to identify the type of EBSA, the criteria described, the primary taxonomic features described, the role of endemic species and the role of connectivity used in the individual EBSA description.

Although reviewing EBSAs should be an iterative and continuing process, this review provides an initial benchmark of the context and status of the global collection of EBSAs at this point in time. We hope that it will provide the basis for future reviews as well as potential refinements of EBSA descriptions.

Results

Global Distribution of EBSAs

The scope of the 14 regional EBSA workshops to date have covered more than 80% of the world's oceans and inland seas; generating descriptions of 321 EBSAs that incorporate every type of marine ecosystem and crossing all ocean basins, with the exception of the Southern Ocean and Antarctic ecosystems. These EBSAs also cross jurisdictional boundaries: 181 EBSA reside within a single national jurisdiction, while 67 more cross more than one national jurisdiction; 38 are transboundary incorporating one or more national jurisdictions and ABNJ, while 33 are located solely in ABNJ (Figure 1). Two EBSAs have no spatial information associated with them.

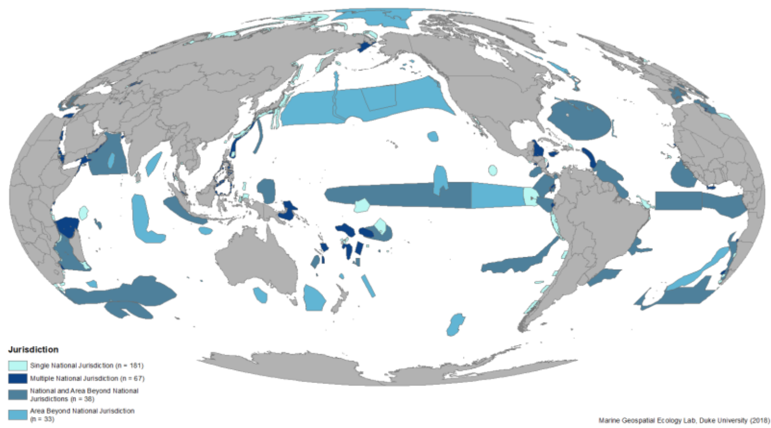

Figure 1: The global distribution of EBSAs across jurisdictions.

The mean latitude of EBSAs skews towards the northern hemisphere, where 69% of EBSAs are located based on the location of the "center" of the EBSA (as defined its mean centroid) (Figure 2). The remaining 31% are located in the southern hemisphere, from 0 to 60 degrees south. The disparity is partially due to the location of EBSA workshops around the world, which cover more of the available area in the northern hemisphere than in the southern.

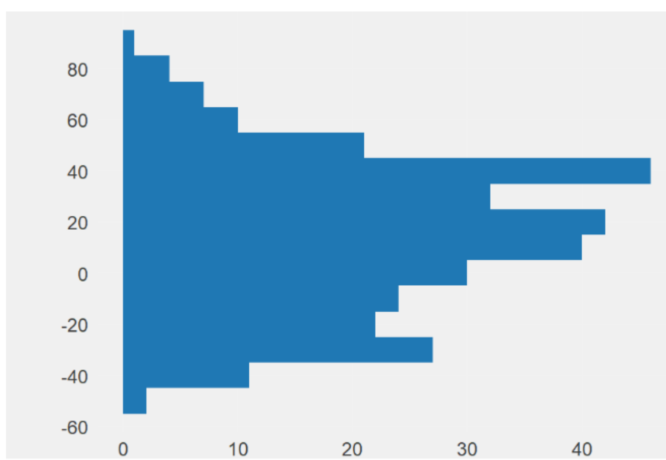

Figure 2: Number of EBSA described by latitude

The majority of EBSAs (68%) are located within 170 km of shore, while 4% are located up to nearly 3600 km from major shorelines[2]. This near-shore distribution of EBSAs is also seen in the distribution of EBSAs across depths: 43% of EBSAs are on the continental shelf between 0 and 200 meters depth, and only 2 EBSAs have mean depths within the hadal zone from 6000 to 7000 meters (Figure 3).

[2] This shoreline assessment only assesses the distance from major land masses, and excludes small island chains in the middle of ocean basins to provide an overall sense of how distant EBSAs are located from large continents.

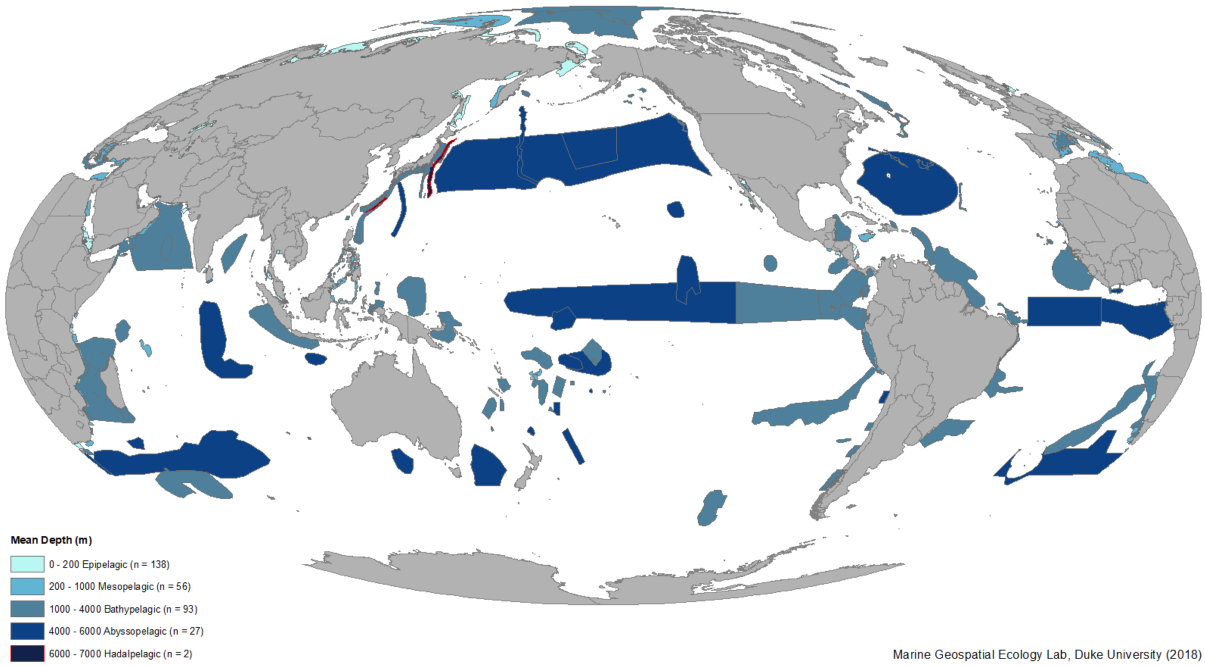

Figure 3: Mean depth of EBSAs. EBSAs outlined in red are the only EBSAs that contain hadal depths.

Biogeographic distribution of EBSAs

The broad-scale distribution of EBSAs described above can be complimented by an understanding of how EBSAs are distributed relative to available global biogeographic classifications. This is particularly critical in understanding potential gaps in description of EBSAs to date. While biogeographic classifications are commonly used to support representative approaches to spatial planning and representativity is a criterion for the development of networks of protected areas (see Decision IX/20 Annex II), these classifications also have utility in describing geographic and ecological gaps in the description of individual sites. Biogeographic classifications are based on underlying similarities in biological communities or physical proxies. If entire provinces, ecoregions or Large Marine Ecosystem (LMEs) have few EBSAs or no EBSAs, then an obvious gap exists. A second consideration here is that the biogeographic classifications provide a setting for understanding the relative importance of an EBSA. Within each province, ecoregion or LME, it should be possible to identify areas that contribute more or less to meeting the EBSA criteria.

The Global Open Ocean and Deep Seabed (GOODS) biogeographic classification (UNESCO 2009) has been investigated in tandem with the development of the EBSA process, including through joint expert workshops and the use of the GOODS report to inform some of the boundaries of regional EBSA workshops. For these reasons, we focus this assessment on the GOODS pelagic, bathyal and abyssal classifications (as updated by Watling et al. (2013)), but also include information from GIS analyses done on the Longhurst pelagic province, the Glasgow mesopelagic provinces from Sutton et al. (2017), Large Marine Ecosystems (LMEs; Sherman, 1991), and the Marine Ecoregions of the World (MEOWs; Spalding et al., 2007).

Three of the GOODS pelagic provinces contain no EBSAs. All 3 are in regions in the southern hemisphere not covered by a regional EBSA workshop (Figure 4). The area of ten provinces were more than 30% covered by EBSAs, and 13 provinces had 10-30% area overlap with EBSAs. The remaining 10 provinces have less than 10% coverage by EBSAs (Figure 5). While some of these provinces also largely fell outside workshop boundaries (e.g., the Antarctic Polar Front and the North Atlantic Transitional province), others have been reviewed in EBSA workshops (e.g., the East Asian Seas workshop).

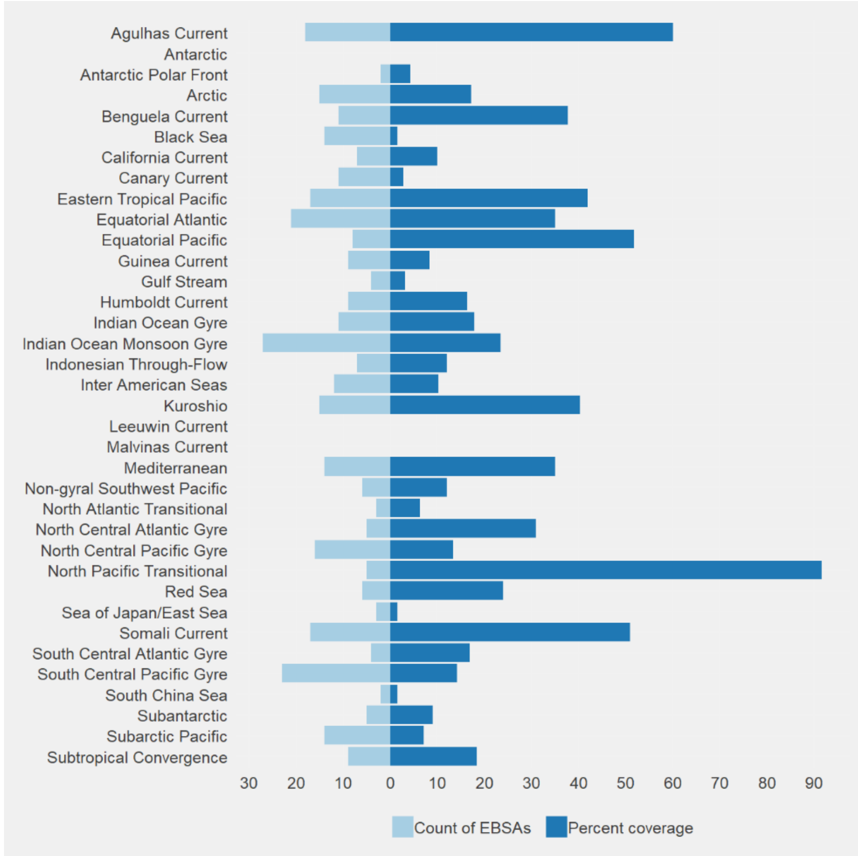

Figure 5: Number of EBSAs and percent coverage within GOODS pelagic provinces

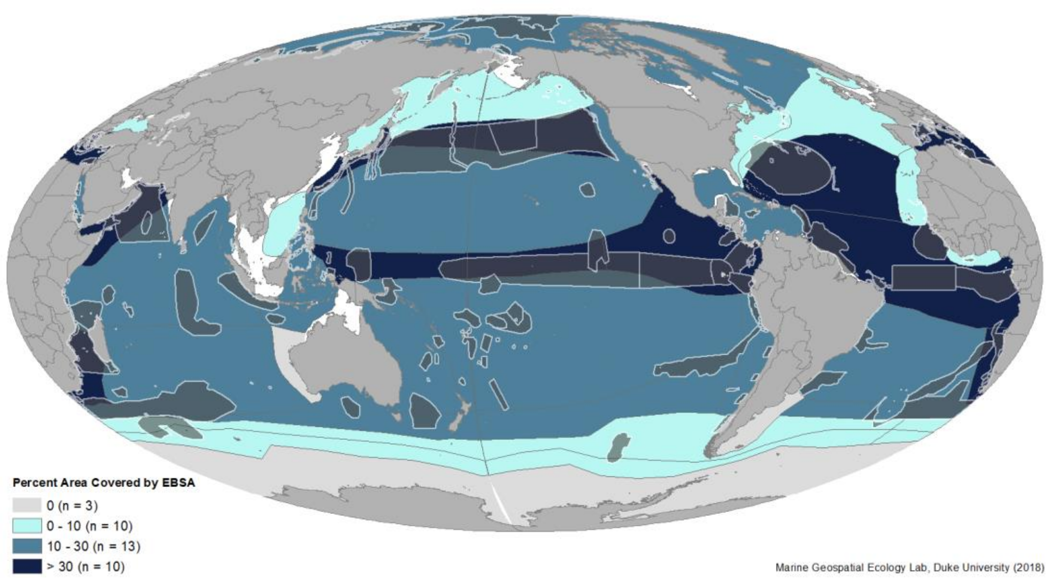

Figure 4: Overlap of EBSAs and the Global Open Ocean and Deep Sea (GOODS) biogeographic pelagic classification.

Of the 50 Longhurst biogeographic provinces (Longhurst 2007), the majority have 10-30% area overlap with EBSAs. Eighteen provinces across the globe have greater than 30% overlap with EBSAs, while nine provinces have less than 10% overlap with EBSAs, and two Atlantic Ocean basin provinces do not overlap with any EBSAs. The provinces that have little to no overlap with described EBSAs largely fall into the same categories as those described for the GOODS provinces, except for the E. India Coastal Province.

Half of the provinces in the mesopelagic classification characterized by Sutton et al. (2017) have area overlap with EBSAs ranging from 10 to 30%. A quarter of the provinces have less than 10% overlap with EBSAs. Two provinces in the Indian Ocean, two in the Pacific Ocean, and three in the Atlantic Ocean all have greater than 30% area overlap with EBSAs. The North Atlantic Drift province is the only mesopelagic province without any EBSAs.

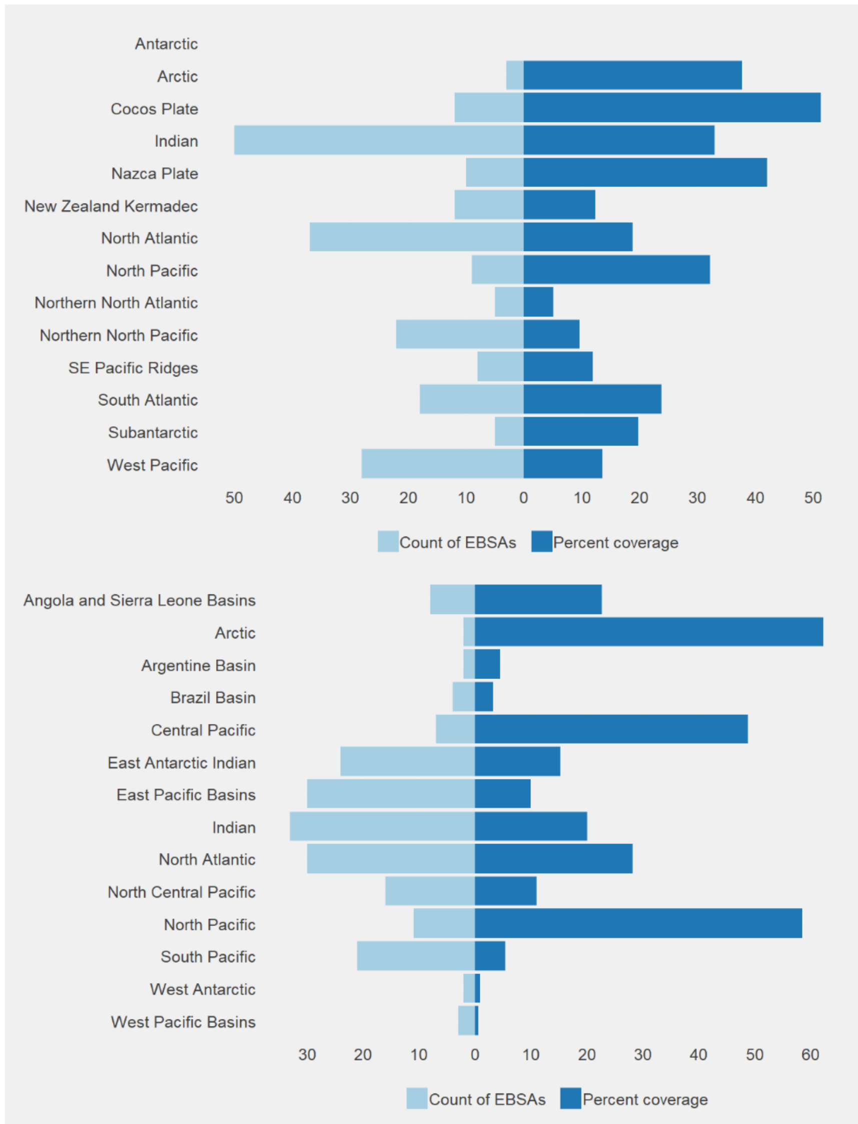

Figure 6: Number of EBSAs and percent coverage of GOODS benthic provinces - Bathyal (top); Abyssal (bottom)

Going deeper, five GOODS bathyal provinces have greater than 30% area overlap with EBSAs, three of which are located in the Pacific Ocean basin (Figure 6). Six provinces have 10 to 30% area overlap with EBSAs, and two have less than 10% overlap. The geographic scope of the regional EBSA workshops again precludes EBSA in the Antarctic province. Deeper still, all of the GOODS abyssal provinces overlap with at least one EBSA, but a new gap is identified in the West Pacific Basin province. Three provinces have area overlap greater than 30%, while 6 provinces range in area overlap from 10 to 30%. Finally, 5 abyssal provinces have less than 10% overlap with EBSAs.

EBSAs overlap with Large Marine Ecosystems (Sherman 1991) within EBSA workshop boundaries across all ranges. Twelve LMEs have greater than 30% area overlap with EBSAs (Figure 7). Sixteen LMEs have between 10 and 30% area overlap with EBSAs, and the remaining 14 LMEs have less than 10% overlap with described EBSAs. A more detailed and ecologically relevant look at the same coastal zone is possible using the 172 Marine Ecoregions of the World (MEOW; Spalding et al. 2007). In this case, we see that nearly a third of ecoregions have less than 2% overlap with described EBSAs (Figure 7), and 39 have no EBSAs at all. While many of these fall within the jurisdictions of countries who opted not to include their EEZs within workshop boundaries, the explanation for many others is less clear. Alternatively, 40 ecoregions have greater than 30% area overlap with EBSAs, and 38 have area overlap ranging from 10 to 30%. For ecoregions within EBSA workshop boundaries, 39 do not intersect with any EBSAs.

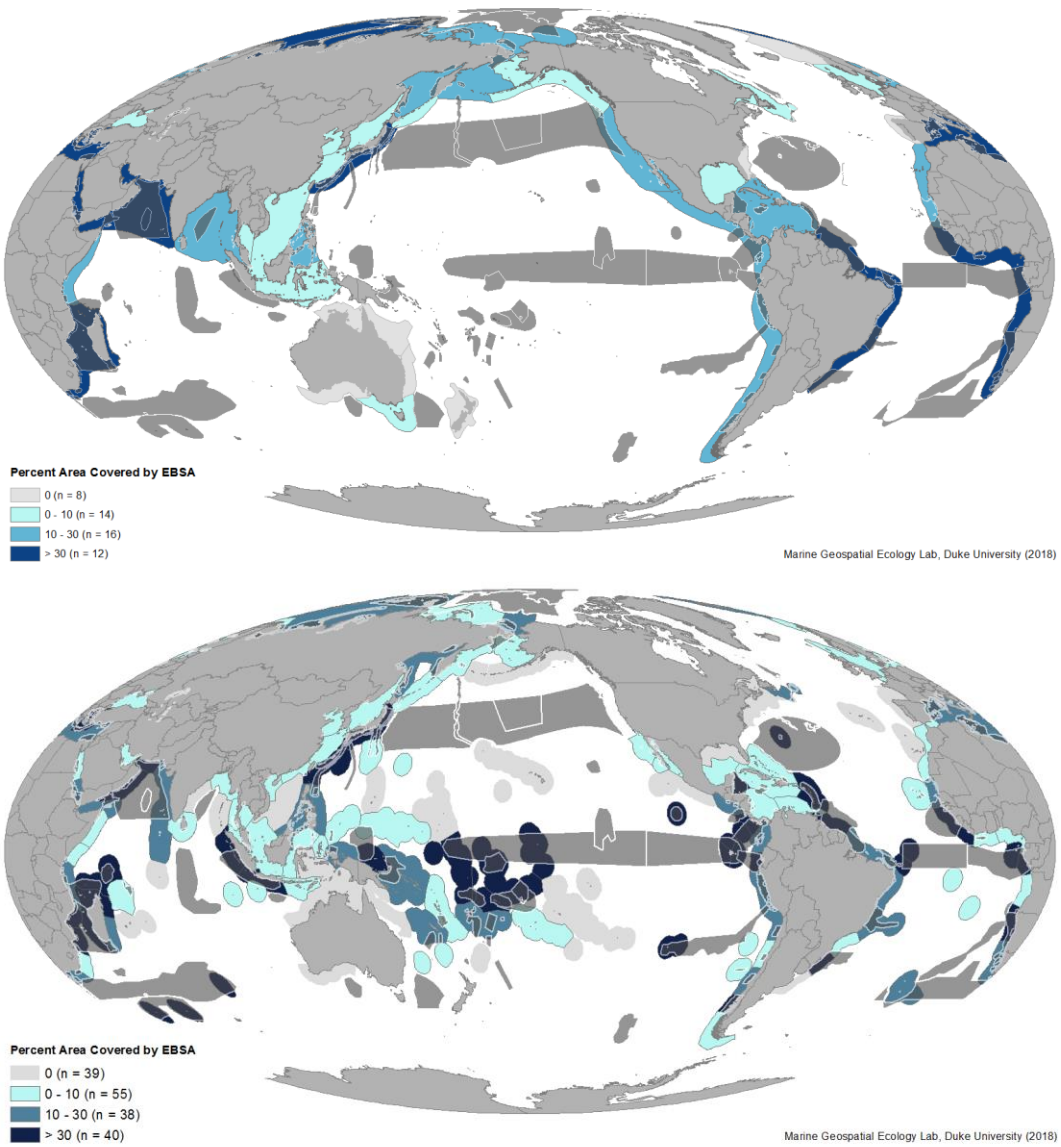

Figure 7: Number of EBSAs in Large Marine Ecosystems (LMEs; top) and Marine Ecoregions of the World (MEOWs; bottom).

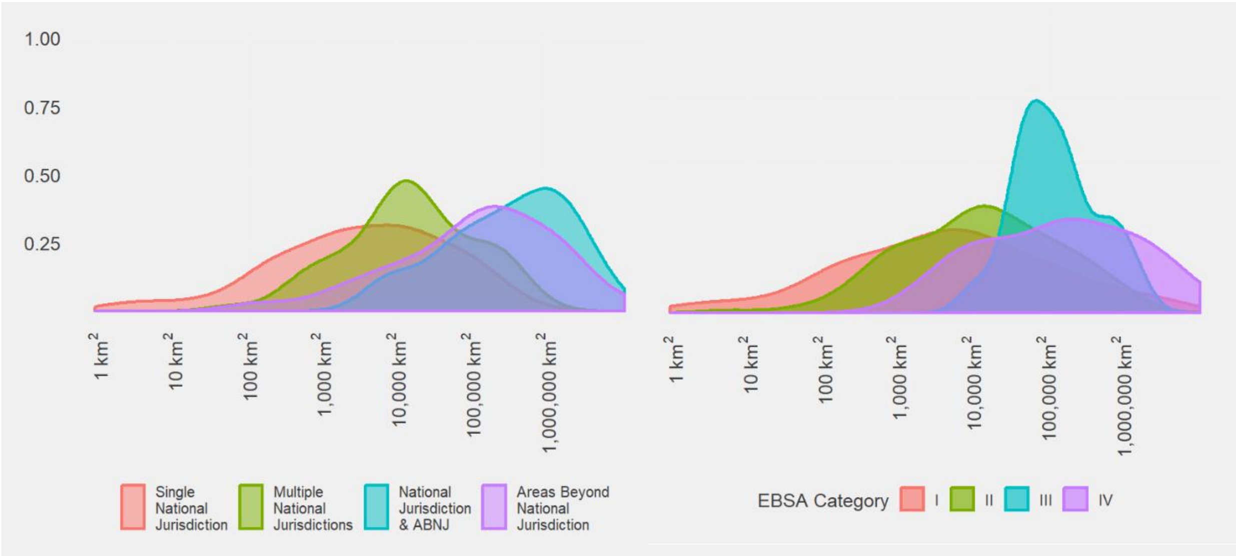

Figure 8:Size distribution of EBSAs by jurisdiction (left) and EBSA category (right)

Size and Categorization of EBSAs

EBSAs span at least five orders of magnitude in size and can include one or more ecosystems that vary temporally on scales of days to centuries (Figure 8). To add precision to their definition and monitoring, a classification of EBSAs into four descriptive types has been proposed (CBD 2013; Johnson *et al.* 2018). Specifically, four types of EBSAs have been identified: Type 1 – static/fixed features; Type 2 multiple (grouped) static features; Type 3 – ephemeral features and Type 4 - dynamic features. As a first step in this review of EBSAs, each template was reviewed to determine if the feature(s) described contained a single component or multiple grouped components, and if the features were static, ephemeral or dynamic. Together, these characteristics allowed for the classification of all EBSAs into one of the four categories (Figure 9). EBSA categories were not homogenously distributed across jurisdictions: the vast majority of EBSAs with in one or multiple national jurisdictions were single or grouped static features (> 86%), with few dynamic features described. Alternatively, dynamic features made up a far greater proportion of transboundary EBSAs, including ABNJ and EBSAs residing solely in ABNJ (> 31% and 50% respectively). It is important to note that this classification of EBSAs was first discussed during the regional workshop for the North Pacific after at least four other workshops (i.e., Western South Pacific, Wider Caribbean and Western Mid-Atlantic, Southern Indian Ocean, and the Eastern Tropical and Temperate Pacific) had taken place, and such classification has not been formally considered or discussed by the CBD Conference of the Parties. While this might have led to differences in willingness to describe ephemeral or

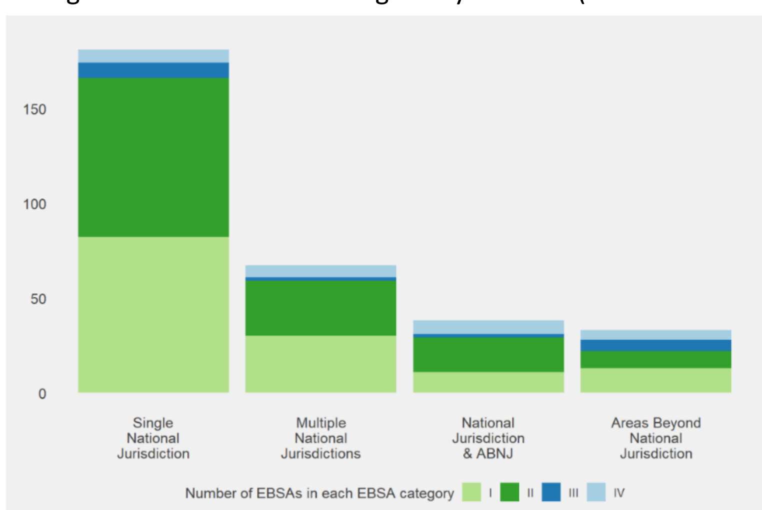

Figure 9: Frequency of EBSA categories by jurisdictional type

dynamic EBSAs in other workshops, no differences are obvious and, in fact, the Eastern Tropical and Temperate Pacific workshop described the most ephemeral or dynamic features (Figure 10).

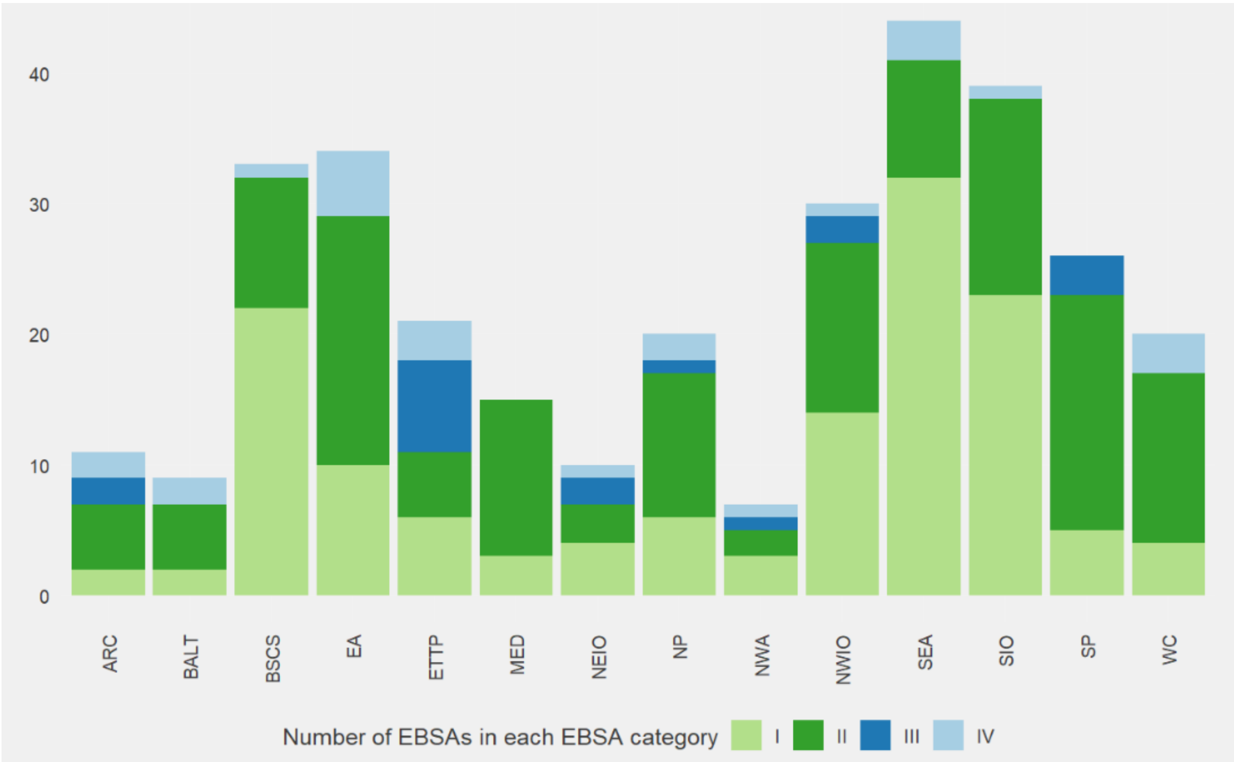

Figure 10: Frequency of EBSA categories across all workshops

Primary Ecosystems

Hundreds of government experts and hundreds more intergovernmental and non-governmental experts collaborated to develop the EBSA descriptions (Bax *et al.* 2016). For greater than a third (n = 112) of the EBSA descriptions, a single factor appears to be used as a rationale for identifying the EBSA (Figure 11). Even when an EBSA is described based on multiple factors, it is feasible to identify the primary ecosystem(s) on which the description is based (Figure 12). Deep-sea geomorphic features were the most commonly identified primary ecosystem type. This category included abyssal plains, ridges, submarine canyons, troughs, trenches and fracture zones, but was dominated by seamounts/knolls/guyots. Certain habitat types (e.g., mangrove forests; n=4) appear to be anomalously infrequent, but are frequently described together with other habitat types (e.g., coral reefs or wetlands, estuaries and macroalgal beds). Thus, while the infrequency of certain habitat types appearing as primary ecosystem types in a given workshop (Figure 13) does not necessarily signal that the habitat-type was not fully considered, closer review and better delineation of important habitats individually is necessary to support improved monitoring and management by competent authorities. For example, further review could look at the lack of any open-

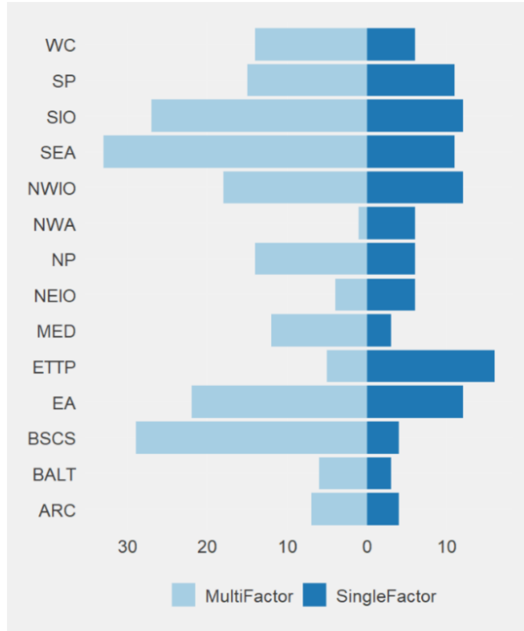

Figure 11: Number of EBSAs described as being important due to a single or multiple factors

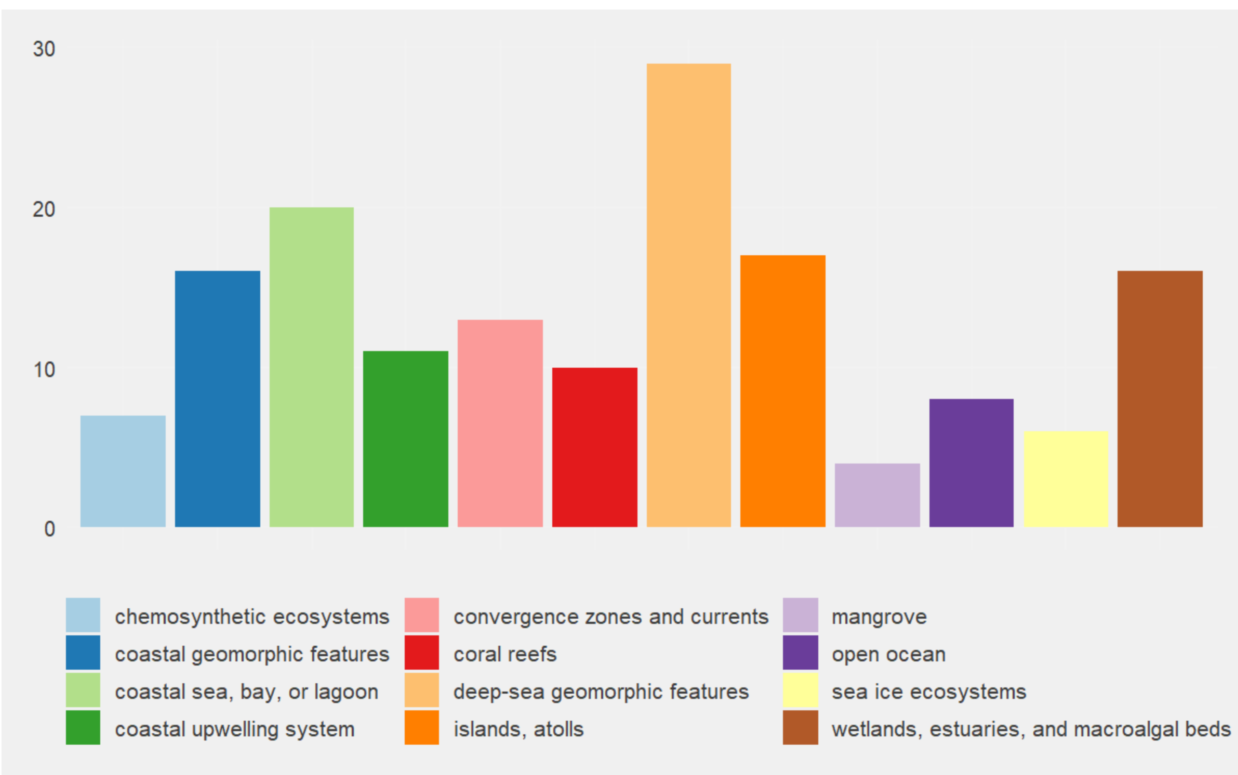

Figure 12: Frequency of primarily ecosystem types used to identify EBSAs (coarsely classified)

ocean or chemosynthetic ecosystems as primary ecosystems in the Wider Caribbean and Central Mid-Atlantic workshop, the absence of coral reefs as a primary ecosystem type in the Northeast Indian Ocean, or identify why mangroves are not a primary ecosystem in South Pacific workshop EBSA descriptions.

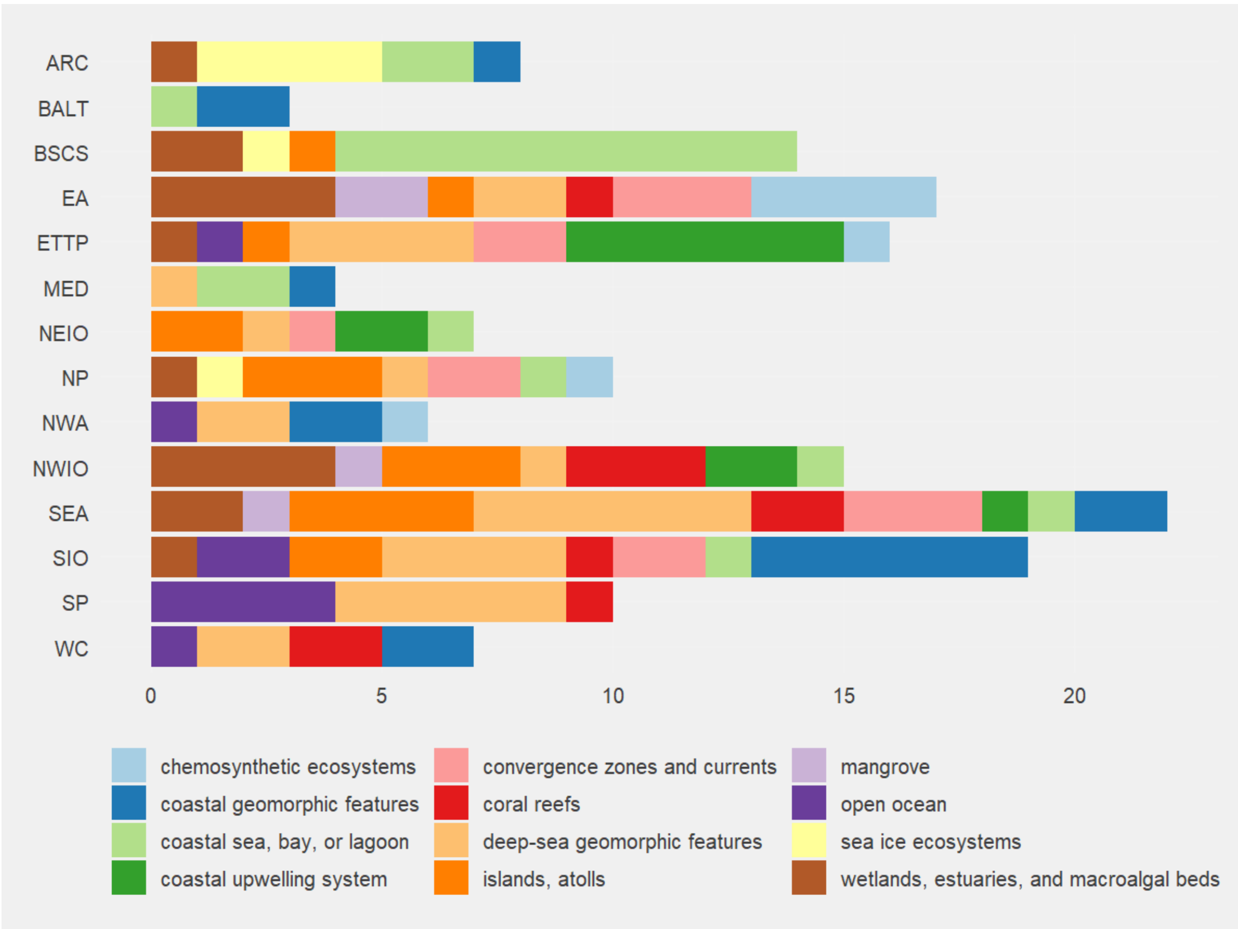

Figure 13: Frequency of primary ecosystems (coarsely described) by workshop

The distribution of primary ecosystems described in the EBSA templates can also be examined by EBSA and jurisdiction type (Figure 14). While Type I & II EBSAs (i.e., static/fixed individual or grouped features) are composed of 9 – 11 different primary ecosystems, Type III & IV EBSAs were refered to only 4 ecosystem types: sea-ice ecosystem, open-ocean ecosystems, convergence zones and currents, and coastal upwelling systems. The majority of EBSAs reside in a single national jurisdiction. Coastal sea, bay or lagoon features and islands or atolls each accounted for more than more than 44% of the primary ecosystems identified. Deep-sea geomorphic features are common foci of EBSAs across all jursidiction types, and make up a particularly large portion (> 30%) of transboundary EBSAs, including EBSAs than span areas within and areas beyond national jurisdiction.

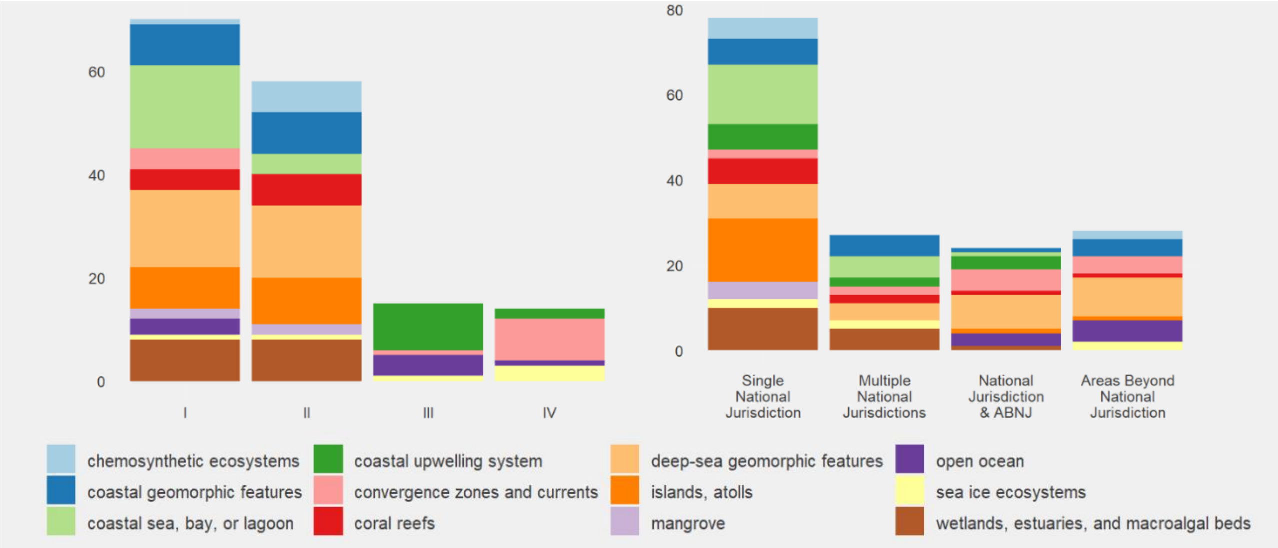

Figure 14: Frequency of primary ecosystems by EBSA type (top) and jurisdiction type (bottom). Note: primary ecosystem type could not be identified for every EBSA as some referred equally to more than one ecosystem type.

Distribution of ecosystems in EBSAs

Together with the analysis of EBSA templates to understand their intent, we analyzed global habitat datasets to derive more information about what types of habitats are likely covered by EBSAs. The existence of a certain ecosystem type within an EBSA does not mean that the EBSA was described because of the importance of that ecosystem, but it helps to identify gaps in individual EBSA descriptions and thematic coverage of ecosystems at a regional level.

EBSA overlap with coral reef, mangrove, and seagrass habitats was assessed using the UNEP World Conservation Monitoring Centre data on the global distribution of these habitat types (UNEP-WCMC 2018). The coral reef dataset was most recently updated in 2010, the mangrove distribution was updated in 2011, and the seagrass distribution was updated in 2017.

The majority of EBSAs do not overlap at all with coral reef habitat, and those that do intersect mainly overlap up to 10% of the EBSA area (Figure 15). Only 6 EBSAs have percent area overlap ranging from 10 to 30%, and the remaining 94 have overlap lower than 10%. Of the 100 EBSAs with coral reef habitat, only 11 have mixed jurisdiction between national and area beyond national jurisdiction (ABNJ), likely pertaining to cold-water corals in deep-sea ecosystems. The remaining 89 EBSAs are contained entirely within one or more national jurisdictions. On the whole, these 100 EBSAs containing coral reef habitat cover 26% of the global reef habitat.

Of the 95 EBSAs that have area overlapping with mangrove habitats, only one has overlap that composes greater than 10% of the EBSA's total area (Figure 15). The remaining 94 have overlap with mangrove habitat under 10%. All of the EBSAs with mangrove overlap have some level of national jurisdiction within them. Ten EBSAs have mixed jurisdiction between national and ABNJ, while the remainder are contained within one or more national jurisdictions. These 95 EBSAs contain 7.5% of the global mangrove habitat.

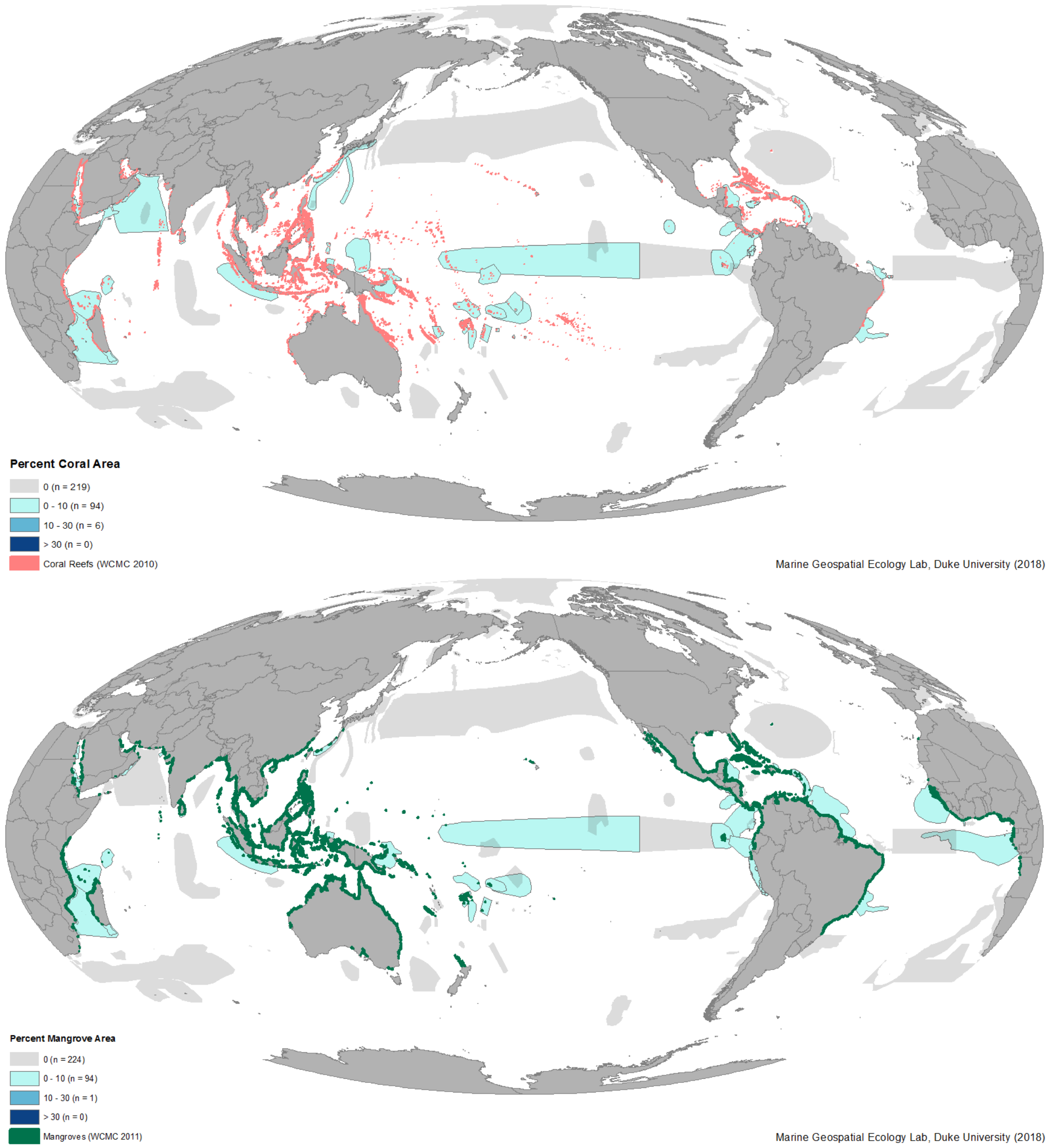

Figure 15: Overlap of EBSAs and the global distribution of tropical coral reefs (top) and mangrove forests (bottom).

Fewer EBSAs overlap with seagrass habitat, but the 73 EBSAs that contain seagrass cover 22% of global seagrass habitat. The majority of EBSAs with seagrass beds have less than 10% cover, but 12 EBSAs have over a third of their area covered by seagrass (**Error! Reference source not found.**). All 12 of those EBSAs are coastal EBSAs that are contained entirely within one or more national jurisdictions. For all three WCMC habitat types (i.e., coral reef, mangrove, and seagrass habitats), there are no EBSAs solely within ABNJ that intersect these habitats.

The overlap between EBSAs and hydrothermal vents was limited to active vents, based on the InterRidge classification (2015). There are 642 active hydrothermal vents globally, and 20% of those are contained within EBSAs (Figure 16). These are located across 27 EBSAs, each of which contains anywhere between

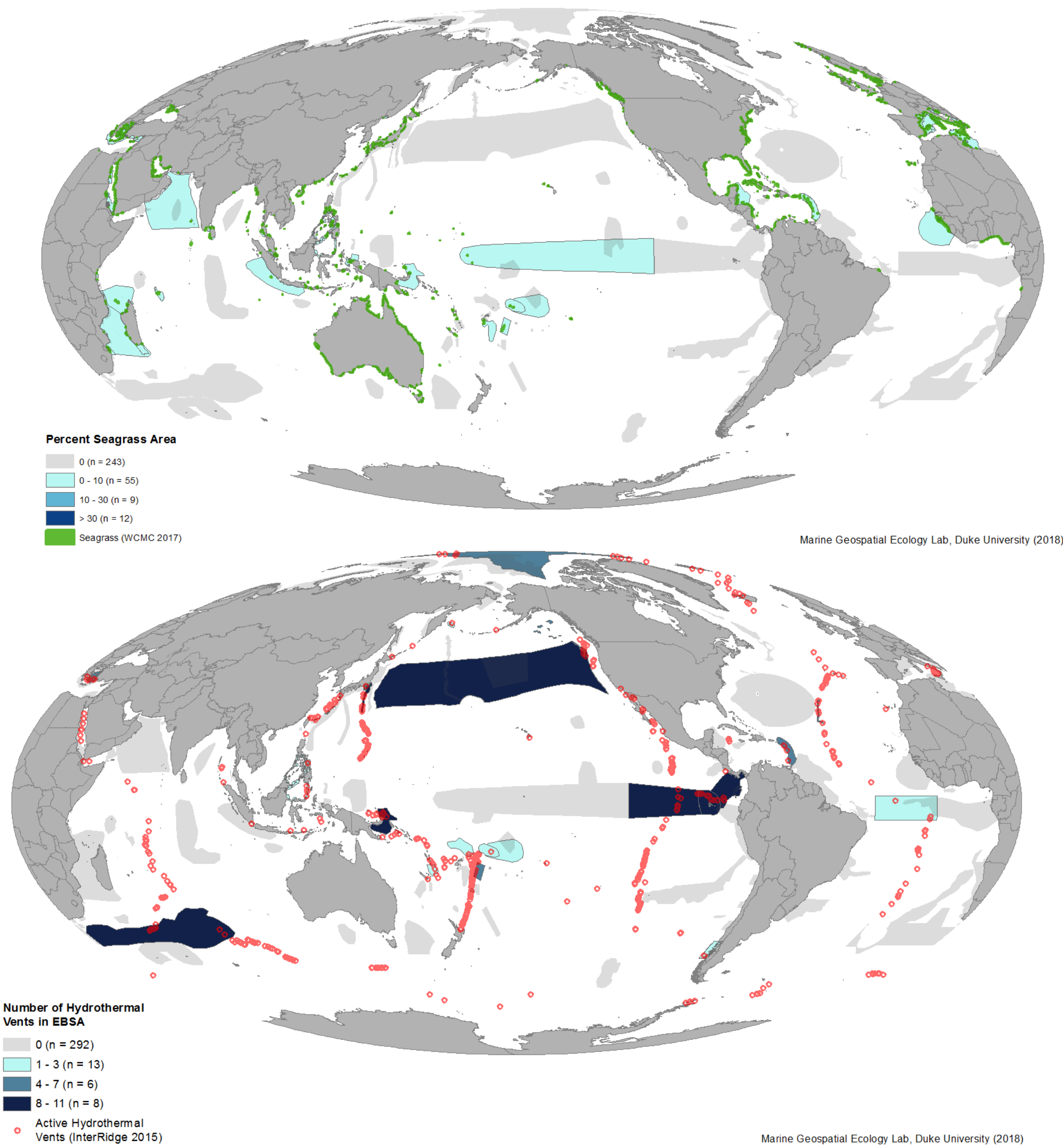

Figure 16: Overlap of EBSAs with the global distribution of seagrass beds (top), and the known and inferred active hydrothermal vent sites (bottom).

1 and 11 hydrothermal vents. There is a similar amount of overlap between EBSAs and seamounts, with 86 EBSAs covering 19% of global seamounts (Kim & Wessel 2011). Half of those EBSAs contain fewer than 11 seamounts.

Roughly 44% of EBSAs contain submarine canyons (Harris *et al.* 2014). The three EBSAs with greater than 30% of their benthic area comprised of submarine canyons are all located nearshore and contained within a single national jurisdiction.

Endemic species

In addition to important ecosystems, endemic species are also a frequently used as rationale for describing EBSAs (n=126). Endemic species are species found only in a specific, generally limited, geographic area or habitat. Endemic species were referenced in all workshop regions and across all four types of EBSAs (Figure 17). Because endemic species are often associated with specific geographic areas or habitats, they are likely associated with several EBSA criteria including uniqueness or rarity, special importance for life history stages of species, importance for threatened, endangered or declining species and/or habitats, and vulnerability, fragility, sensitivity, or slow recovery. References to endemic species include both species and unique habitats. The distribution of endemic species references by EBSA type indicates strong presence of endemics across categories.

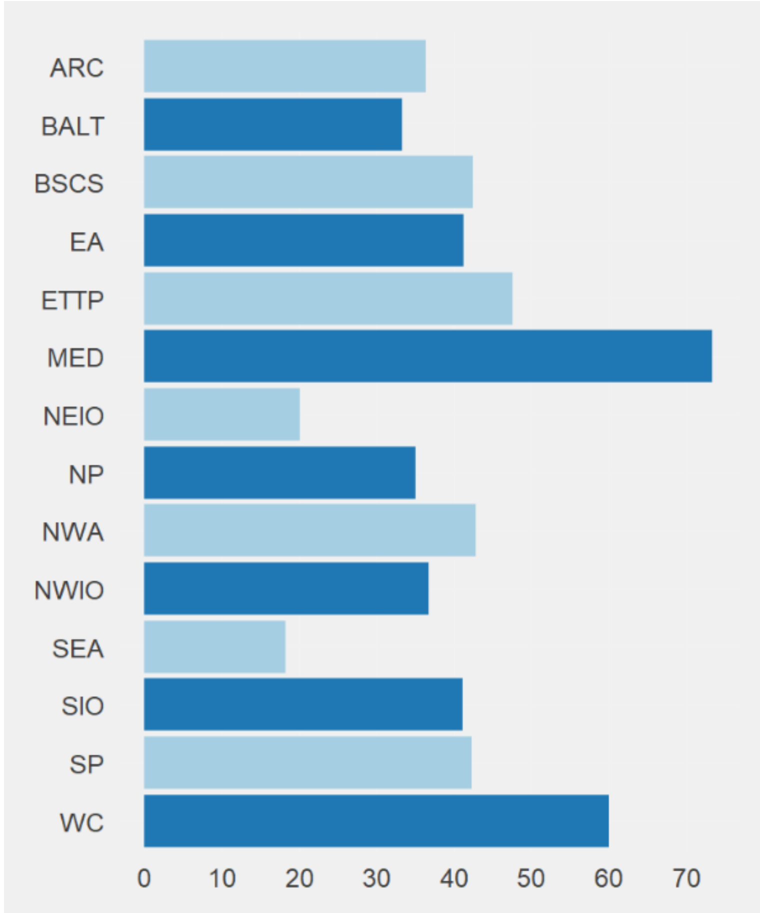

Figure 17: Percent of EBSA descriptions which mentioned endemic species by workshop (top) and EBSA category (bottom)

Connectivity

A number of EBSA descriptions cite the importance of connectivity in the ecological maintenance of the site or the role the site plays in regional connectivity. The review of EBSA descriptions classified them into binary (True/False) categories characterizing the use of connectivity as a key term or attricbute in the description.

Ecological connectivity can be broadly categorized into two types: passive and active forms of movement. Oceanographic (planktonic) connectivity is the main form of passive connectivity and relies on ocean currents that drive larval or planktonic dispersal and which can also transport anthropogenic impacts, such as pollutants, into and out of coastal State waters. Active dispersal, on the other hand, arises from directed movement by, *inter alia,* seabirds, sea turtles, marine mammals and fish. This form of dispersal can lead to different types of transboundary movements, from transoceanic migrations straddling multiple EEZs and the high seas, to smaller scale straddling behavior into the high seas. Many of the animals that engage in this type of straddling movement rely on different parts of the ocean to fulfill different life history stages (e.g. from nesting to foraging). Understanding the how areas are connected in space and time and through what types of interactions among species is essential for the implementation of transboundary management strategies.

Oceanographic (planktonic) connectivity

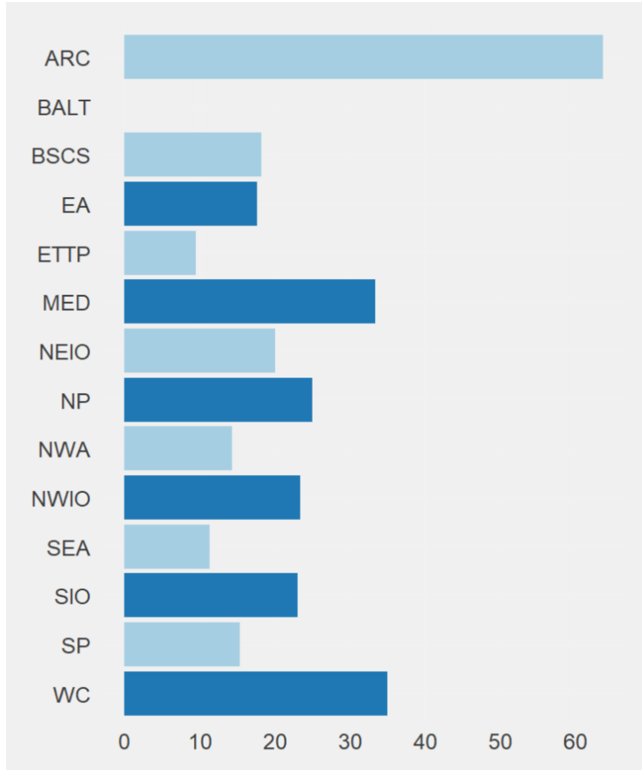

Figure 18: Percent of EBSA by workshop that mention planktonic connectivity

For many marine species, population connectivity is determined largely by ocean currents transporting larvae and juveniles between distant patches of suitable habitat. Because the movement of passive larvae or juvenile animals are principally controlled by physical ocean currents, these connections can span large ocean basin-scale regions. These long-distance connections often contribute to the genetic stability of species metapopulations and stocks by periodically providing recruits from distant populations. The strength of the connections between sites may change seasonally throughout the year or across years with changes seen under major climate cycles such as el Niño or la Niña oscillations (Treml *et al.* 2008). For example, the strength and pattern of oceanographic connections may highlight connections between reefs or spawning areas that connect between national jurisdictions or areas beyond national jurisdictions (Treml *et al.* 2012). These findings clearly highlight the need to examine transboundary flows in the management of marine resources.

Regional analyses have been conducted in the South Pacific (Treml *et al.* 2012) as well as the Caribbean (Schill *et al.* 2015) and have helped to better define the long-distance interdependence of marine ecosystems within these regions. These analyses demonstrate the importance of direct adjacency between near shore (EEZ) areas and offshore (ABNJ) areas as well as more complicated, multi-path connections that may span multiple sites and jurisdictions.

The numbers of EBSA descriptions explicitly addressing oceanographic (planktonic) connectivity was generally low (<10%) and varied between regional workshop area (Figure 18). Descriptions of planktonic connectivity were most associated with larval or juvenile life stages of corals and benthic species or fish spawning areas. EBSAs described in the Southern Indian Ocean, North West Indian Ocean, and Wider Caribbean and Western Mid Atlantic regions have relatively higher rates of planktonic connectivity, likely due to the increased relative importance of coral and benthic species in these regions. The Arctic region also described relatively higher importance of planktonic connectivity, but these references can likely be attributed to higher importance of fish spawning areas.

Migratory (nektonic) connectivity

Migration has been broadly defined as persistent, large spatial scale movements to connect discrete home ranges that help fulfill a species' life history objectives (Milner-Gulland *et al.* 2011). Migration movements are known to be fundamental for the structuring of marine ecosystems given their strong ecological basis: to evade predation, to access spatially distributed temporary resources, or to connect suitable habitats for different life history purposes. Migratory connectivity emerges from persistent movement between habitat patches and frequently straddles jurisdictional boundaries. Understanding and accounting for the transboundary connectivity of migratory species is essential for their conservation and management.

There was a little variation in the importance of migratory (nektonic) connectivity between types of EBSAs, but increasing differentiation between jurisdictions and wide discrepencies between regional workshop areas. The description of migratory (nektonic) connectivity by EBSA type (I – IV) is similar for all types of features (Figure 19). Type-IV and Type-III EBSAs, these types represent significantly fewer, but much larger EBSA areas.

Similarly, when viewed in terms of jurisdictional locations, there were not very large differences between jurisdiction types, though EBSAs that spanned multiple national jurisdictions did have higher citation of migratory connectivity than the other three types (Figure 20). This does accord with both the increased likelihood of observing migrations closer to shore and the frequently along-shore migration pattern of many species (e.g., grey whales).

The role of migratory (nektonic) connectivity in EBSA descriptions also varied substantially

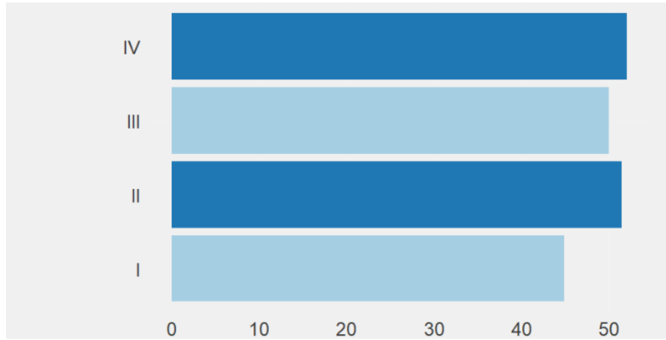

Figure 19: Percent of EBSA descriptions by EBSA Category that mention migratory connectivity

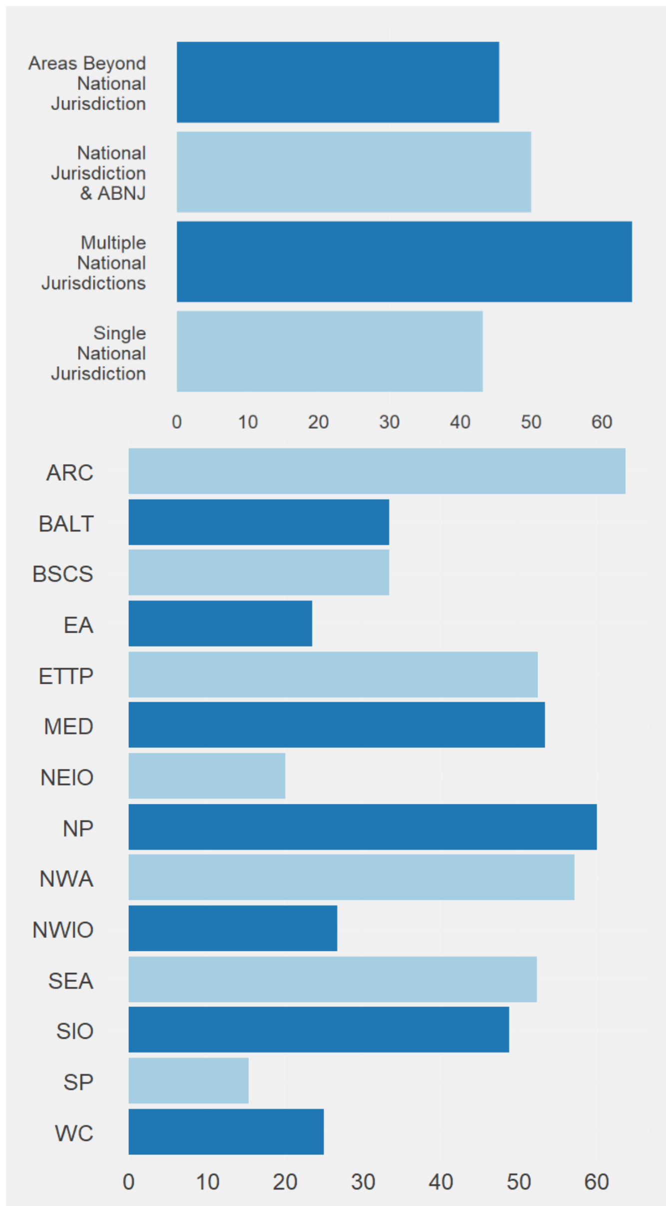

Figure 20: Percent of EBSA description that mention migratory connectivity by jurisdiction (top) and workshop (bottom)

between workshop regions (Figure 20). Some of these general trends can be explained by the proportion of potential migratory life history areas considered in a region. For example; the North-West Atlantic region reports a small number of EBSAs using migratory connectivity in EBSA descriptions. This regional workshop described a relatively small number of EBSAs and a large proportion of these EBSAs were related to deep sea seamount and canyon features.

Connectivity of nutrient flows

In addition to transporting organisms, ocean currents and oceanographic features also transport and redistribute nutrients. The identification of nutrient flows in EBSA descriptions also varied across regional work shop areas. The South-Eastern Atlantic region exhibited the highest rates of nutirent flow rpeorting (~25%) while the North-East Indian Ocean region reported the lowest (~5%).

Existing Management in EBSAs

Since its inception, the description of EBSAs has been associated directly or indirectly with the need for increased management of important areas in the marine realm. Before the 10th meeting of the Conference of the Parties (COP 10) to the Convention on Biological Diversity, the term “Ecologically or Biologically Significant marine Area” was always followed by “in need of protection”. For example, the title to Annex I of Decision IX/20 which contains the EBSA criteria is “Scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats”. At COP 10, the Parties clarified the relationship between the description of EBSAs in Decision X/29 para 26:

> *26. Notes* that the application of the ecologically or biologically significant areas (EBSAs) criteria is a scientific and technical exercise, that areas found to meet the criteria may require enhanced conservation and management measures, and that this can be achieved through a variety of means, including marine protected areas and impact assessments, and *emphasizes* that the identification of ecologically or biologically significant areas and the selection of conservation and management measures is a matter for States and competent intergovernmental organizations, in accordance with international law, including the United Nations Convention on the Law of the Sea;

Following this decision, subsequent COP decisions have emphasized this point as well and discussion has moved to understanding how EBSAs can inform enhanced conservation and management. A first step in this process is understanding current management within EBSAs. As with previous sections, this study sought to understand levels of management within EBSAs through a review of the EBSA descriptions and through GIS overlays.

References to existing management took various forms in the EBSA descriptions, including sectoral management (most commonly fisheries through national agencies, but also through RFMOs), cross-sectoral management (e.g., national parks, reserves or MPAs), or listing by RAMSAR or the World Heritage Convention. Looking at the number of EBSAs that mention existing management in the EBSA description by workshop indicates clear geographic differences in the level of management and conservation (Figure 21). The percent of EBSAs with some level of management mentioned in the description ranged from 11.5% in the Western South Pacific to 88.9% in the Baltic Sea. Across all workshops, the average proportion of EBSAs that mentioned enhanced management was 52.7%. Generally, the types of management actions that were mentioned fall into one of the following categories: national and state parks and reserves, MPAs, Ramsar sites, UNESCO World Heritage Sites, fisheries closures/measures, VMEs and other RFMO closures, Natura 2000 sites, Specially Protected Areas of Mediterranean Importance (SPAMIs), UNESCO Biosphere Reserves, and measures stemming from the Convention on Migratory Species family of instruments (e.g., the IOSEA Sea Turtle MoU and the Dugong MoU). Overlap with these management measures or listings does not imply that the EBSA was described for the same reasons, or that the management measures necessarily address the factors driving the EBSA description. However, in most cases there is likely to be some relationship between the management measure and the importance of the site as described in the EBSA template.

Further insight into potential gaps in management of EBSAs can be gained by looking at when existing management measures were mentioned in the description relative to the jurisdiction type and the EBSA type. Management measures were mentioned more frequently in EBSAs that resided wholly within one or more national jurisdictions than in EBSAs that included ABNJ (Figure 22). This is logical, as many consider the framework for conservation and management of biodiversity fragmented in ABNJ (Ban *et al.* 2014).

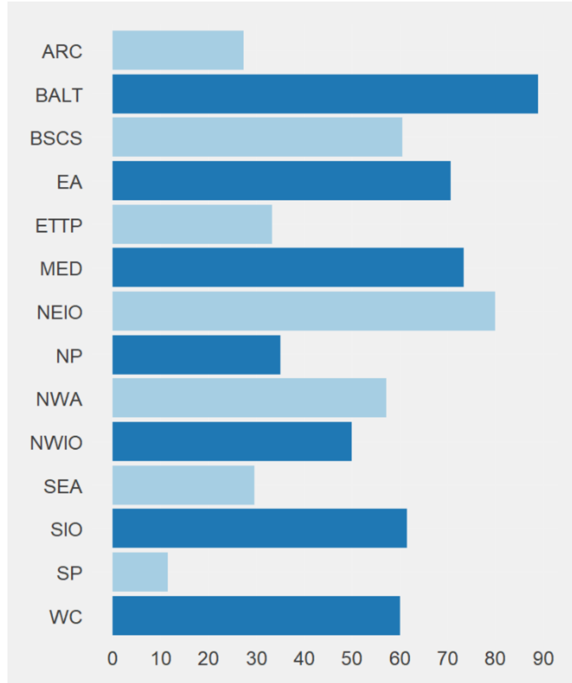

Figure 21: Percent of EBSA descriptions that mention existing management measures by workshop region.

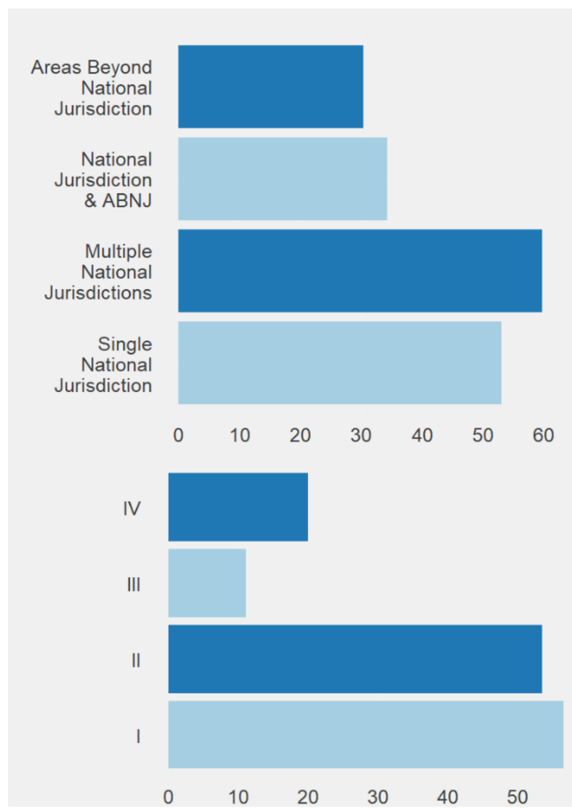

Figure 22: Percent of EBSA descriptions that mention enhanced management by jurisdiction type (top), and EBSA Category (bottom).

Looking across EBSA types, existing management measures are mentioned significantly less frequently in ephemeral and dynamic EBSAs (Categories III & IV; Figure 22). Existing management measures were mentioned in more than 50% of static/fixed EBSAs, but in 20% of dynamic EBSAs and 11.1% of ephemeral EBSAs. Ephemeral EBSAs are largely coastal upwelling zones and foraging areas for megavertebrates (particularly, seabirds). Coastal upwelling zones tend to be important areas for fisheries, and thus may receive enhanced management in other forms (effort-based control of fisheries and quotas). Similarly, open-ocean foraging areas for megavertebrates may be managed through gear modification or restrictions and operational changes in extractive activities that were not captured by the experts at the EBSA workshops. Regardless, further investigation is needed for whether appropriate governance frameworks exist and are being utilized for the spatial management of ephemeral and dynamic EBSAs. Significant work has been done over the last decade on Dynamic Ocean Management which may inform enhanced management of these EBSAs (Maxwell *et al.* 2015; Dunn *et al.* 2016).

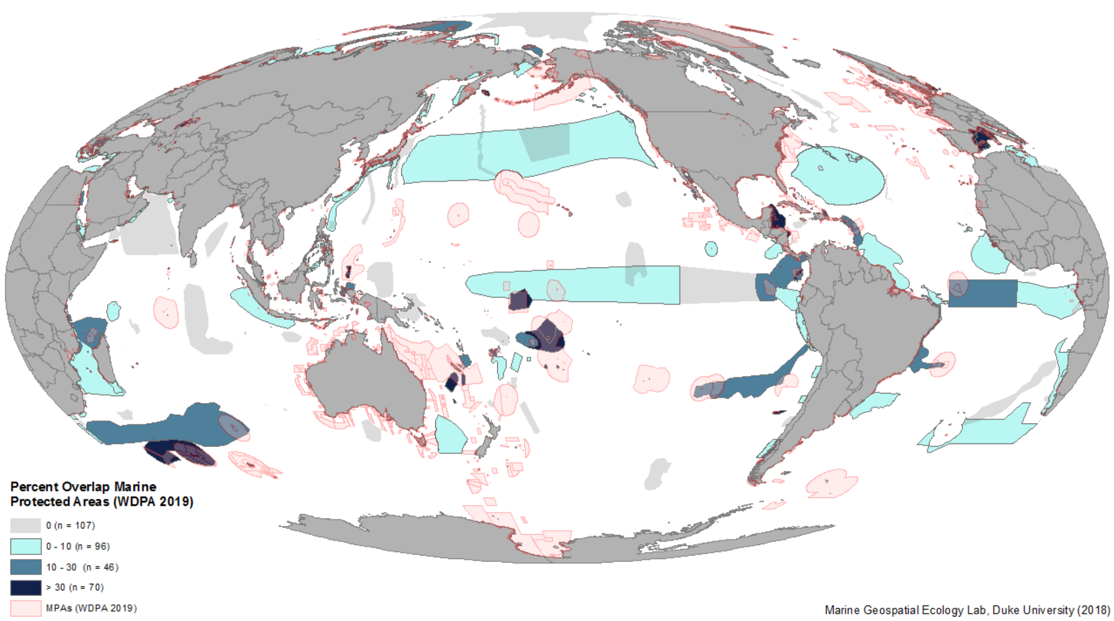

Figure 23: Overlap of EBSAs with the World Database on Protected Areas (WDPA).

The review of EBSA templates was supported by geospatial analyses of available global data on the distribution of measures offering enhanced management (MPAs, APEIs and VMEs) or promoting such approaches (WHS, UNESCO Biosphere Reserves, Ramsar sites, Important Bird Areas). Nearly two-thirds of described EBSA boundaries overlap with marine protected areas (UNEP-WCMC, 2016). Of these, 70 have over a third of their area overlapping with one or more MPAs, while 18 of those have 99% or more overlap, indicating that the EBSA and MPA processes likely informed the description of one another (Figure 23). Over half of described EBSAs have overlap with MPAs and occur within one or more national jurisdictions. Roughly 11% of EBSAs have overlap with MPAs and occur at least partially within ABNJ.

Areas designated as Vulnerable Marine Ecosystems by Regional Fisheries Management Organizations (FAO, 2016) had limited overlap with EBSAs. Eleven EBSAs intersect with VMEs across 5 EBSA workshop regions (Figure 24). Certain workshop areas have overarching policies that preclude the need for VMEs (e.g., the deep-sea bottom-trawling closure in the Mediterranean), but gaps in geographic coverage of deep-sea RFMOs likely contribute to the lack of VMEs in certain EBSA workshop regions. For example, none of the EBSA workshops that took place within the Pacific Ocean basin overlap with VMEs, highlighting a large gap in VME locations.

EBSAs overlap with 48 sites designated as Ramsar Wetlands of International Importance (Ramsar 1971), but for those EBSAs that overlap with Ramsar Sites, only 3 Ramsar Sites overlap with greater than 10% of the area of the individual EBSA. As expected, all of these coastal wetlands are contained within one or more national jurisdictional boundaries and do not extend into ABNJ.

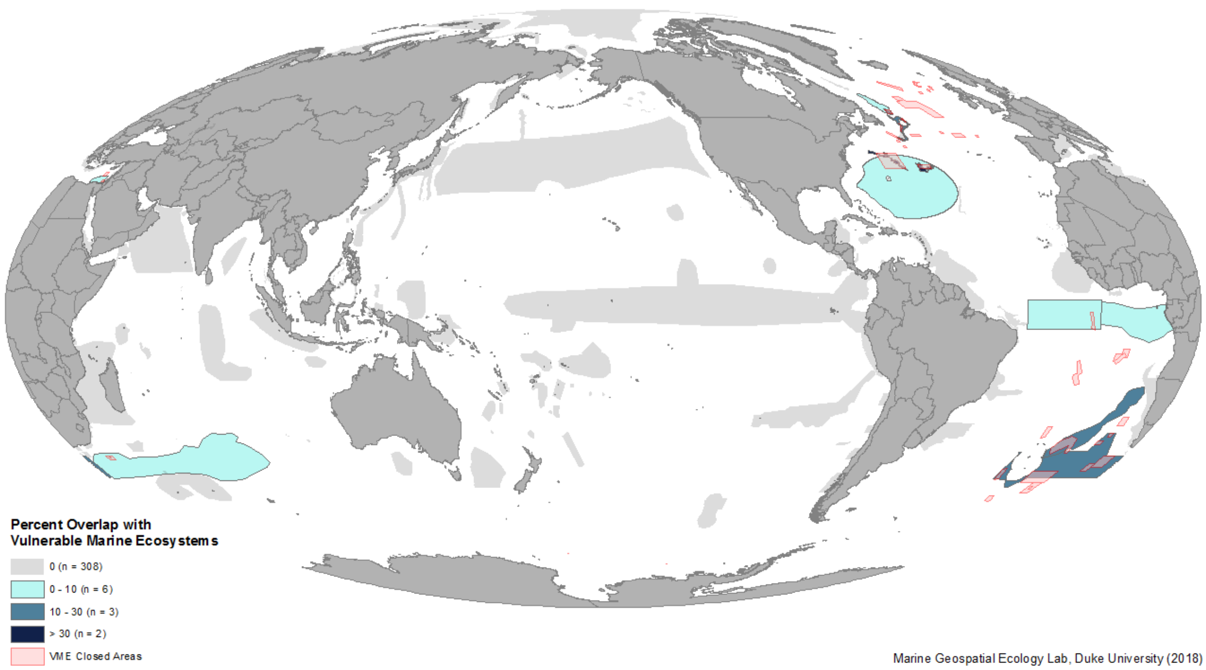

Figure 24: Overlap of EBSAs with the FAO database of Vulnerable Marine Ecosystems (VMEs).

Even fewer EBSAs overlap with UNESCO World Heritage Sites (2013), with just 9% of EBSAs intersecting with these sites (n=29). Twenty of these EBSAs overlap by less than 10% of their area. For the 3 EBSAs with greater than 30% overlap with UNESCO sites, all occur within a single country's national jurisdiction. Interestingly, nine EBSAs that overlap World Heritage Sites are transboundary and incorporate some area in ABNJ. As appropriate, consideration should be given to whether the ABNJ portions of these EBSAs are vital to the functioning of the WHS and thus should be included in the WHS designation.

Lastly, while Important Bird Areas designated by Birdlife International do not have direct management implications and are not administered by an intergovernmental organization, they are recognized by the Convention on Migratory Species and the Convention on Biological Diversity, being frequently mentioned in decisions and resolutions by those and other IGOs including RFMOs. Over half of EBSAs overlap with Important Bird Areas (IBAs; Donald et al., 2016). Of those 168 EBSAs, the majority overlap with IBAs by less than 10% of their area. In total, there are 2700 global marine IBAs, of which 713 overlap with EBSAs.

Methods

Jurisdictions

Analysis of the jurisdictional forms within the EBSA dataset was performed using a geographic information system (GIS) and a set of publicly available datasets. The approach involves using ESRI ArcGIS v 10.5.1 software to run a multi-step geoprocessing model that examines EBSA geographic boundaries as they relate to ABNJ areas and to global EEZs. The EBSA data layer was compiled and maintained by the Marine Geospatial Ecology Lab at Duke University for the CBD. The EEZ layer used in the analysis was downloaded from the Flanders Marine Institute's Marine Regions data center. This layer represents global EEZ merged with land areas which helps address issues with the use of different shorelines in each EBSA workshop.

> Flanders Marine Institute (2014). Union of the ESRI Country shapefile and the Exclusive Economic Zones (version 2). Available online at http://www.marineregions.org/. Consulted on 2018-04-11.
>
> Version 2 of this joint EEZ + Land dataset is built from version 8 of the Marine Regions EEZ database:
>
> Flanders Marine Institute (2014). Maritime Boundaries Geodatabase, version 8. Available online at http://www.marineregions.org/.

Biogeographic Overlays

Analysis of the biogeographic coverage within the EBSA dataset was performed using a geographic information system (GIS) and a set of publicly available datasets. The approach involves using ESRI ArcGIS v 10.5.1 software to run geoprocessing models that calculate the areal overlap of the EBSA dataset with several global biogeographies. The results are maps and tables that describe the area of each biogeographic region covered by EBSAs and a count of the number of EBSA within each biogeographic region.

Global Open Oceans and Deep Seabed (GOODS) – Biogeographic Classification

> UNESCO. 2009. *Global Open Oceans and Deep Seabed (GOODS) – Biogeographic Classification*. Paris, UNESCO-IOC. (IOC Technical Series, 84.)
>
> Watling, L., Guinotte, J., Clark, M.R. & Smith, C.R. (2013) A proposed biogeography of the deep ocean floor. Progress in Oceanography, 111, 91–112.

Large Marine Ecosystems (LME)

> Sherman, K. and Hempel, G. (Editors) 2009. The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas. UNEP Regional Seas Report and Studies No. 182. United Nations Environment Programme. Nairobi, Kenya.
>
> Data available from: http://www.lme.noaa.gov/

Marine Ecoregions of the World (MEOW)

Spalding, M. D. Fox, H. E. Allen, G. R. Davidson, N. Ferdana, Z. A. Finlayson, M. Halpern, B. S. Jorge, M. A. Lombana, A. Lourie, S. A., (2007). Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. Bioscience 2007, VOL 57; numb 7, pages 573-584.

Data available from: http://www.marineregions.org/sources.php#meow

Mesopelagic Biogeography

Sutton, Tracey T., Malcolm R. Clark, Daniel C. Dunn, Patrick N. Halpin, Alex D. Rogers, John Guinotte, Steven J. Bograd, et al. n.d. "A Global Biogeographic Classification of the Mesopelagic Zone." *Deep Sea Research Part I: Oceanographic Research Papers*. https://doi.org/10.1016/j.dsr.2017.05.006.

Longhurst Provinces

Longhurst, A.R. (2006). Ecological Geography of the Sea. 2nd Edition. Academic Press, San Diego, 560p.

(source: VLIZ (2009). Longhurst Biogeographical Provinces. Available online at http://www.marineregions.org/. Consulted on 2013-01-14.)

Habitat and Enhanced Management Overlays

Analysis of the habitat and enhanced management coverage within the EBSA dataset was performed using a geographic information system (GIS) and both publicly and privately available datasets. The approach involves using ESRI ArcGIS v 10.5.1 software to run geoprocessing models that calculate the areal and percent overlap of the EBSA dataset with several global variables. The results are maps and tables that describe the area of each variable covered by EBSAs. For datasets that contained point data, the results were counts of the variable contained by EBSAs.

GEBCO Bathymetry

The GEBCO_2014 Grid, version 20150318, www.gebco.net

WCMC habitats

Coral Reefs: UNEP-WCMC, WorldFish Centre, WRI, TNC (2010). Global distribution of warm-water coral reefs, compiled from multiple sources including the Millennium Coral Reef Mapping Project. Version 2.0. Includes contributions from IMaRS-USF and IRD (2005), IMaRS-USF (2005) and Spalding et al. (2001). Cambridge (UK): UNEP World Conservation Monitoring Centre. URL: http://data.unep-wcmc.org/datasets/1

Mangroves: Giri C, Ochieng E, Tieszen LL, Zhu Z, Singh A, Loveland T, Masek J, Duke N (2011). Status and distribution of mangrove forests of the world using earth observation satellite data (version 1.3, updated by UNEP-WCMC). Global Ecology and Biogeography 20: 154-159. doi: 10.1111/j.1466-8238.2010.00584.x . Data URL: http://data.unep-wcmc.org/datasets/4

Seagrasses: UNEP-WCMC, Short FT (2017). Global Distribution of Seagrasses (version 5). Fifth update to the data layer used in Green and Short (2003), superseding version 4. Cambridge (UK): UN Environment World Conservation Monitoring Centre. URL: http://data.unep-wcmc.org/datasets/7

Hydrothermal Vents

Beaulieu, S.E., Szafranski, K. (2018) InterRidge Global Database of Active Submarine Hydrothermal Vent Fields, Version 3.4. World Wide Web electronic publication available from http://vents-data.interridge.org

Seamounts

Kim, S-S & Wessel, P. (2011). New global seamount census from altimetry-derived gravity data. Geophysical Journal International, 186, 615-631.

Submarine Canyons

Harris, P.T., Macmillan-Lawler, M., Rupp, J. & Baker, E.K. (2014). Geomorphology of the oceans. Marine Geology, 352, 4–24.

WDPA

UNEP-WCMC (2016). World Database on Protected Areas User Manual 1.4. UNEP-WCMC: Cambridge, UK. Available at: http://wcmc.io/WDPA_Manual

IBAs

BirdLife International (2018). Digital boundaries of Important Bird and Biodiversity Areas from the World Database of Key Biodiversity Areas. February 2018 Version. Available at http://datazone.birdlife.org/site/requestgis. [Accessed 19/02/2019].

Ramsar

Ramsar (2019). Ramsar Wetlands of International Importance. Available at http://rsis.ramsar.org:80/geoserver/wfs?request=GetFeature&service=wfs&version=1.0.0&typename=ramsar_sdi:features_published&outputformat=SHAPE-ZIP

UNESCO

UNESCO (2013). World Heritage Marine Programme. Available at http://whc.unesco.org/en/list/

VMEs

FAO (2016). Vulnerable marine ecosystems. Processes and practices in the highseas. Food Agric. Organ. U.N. Fish. Aquac. Techn. Pap.595:185.

Dataset available at http://www.fao.org/in-action/vulnerable-marine-ecosystems/background/vme-tools/en/#download_shapefiles

Assessing the availability of open-access biological data for EBSAs

One of the necessary tasks for the continuous review of EBSAs is to track our ability to acquire biological and ecological data for these regions. In order to create a continuously updatable process, the portal for the Ocean Biogeographic Information System (OBIS.org) has developed a set of standardized tools to allow for automated queries of all EBSA sites.

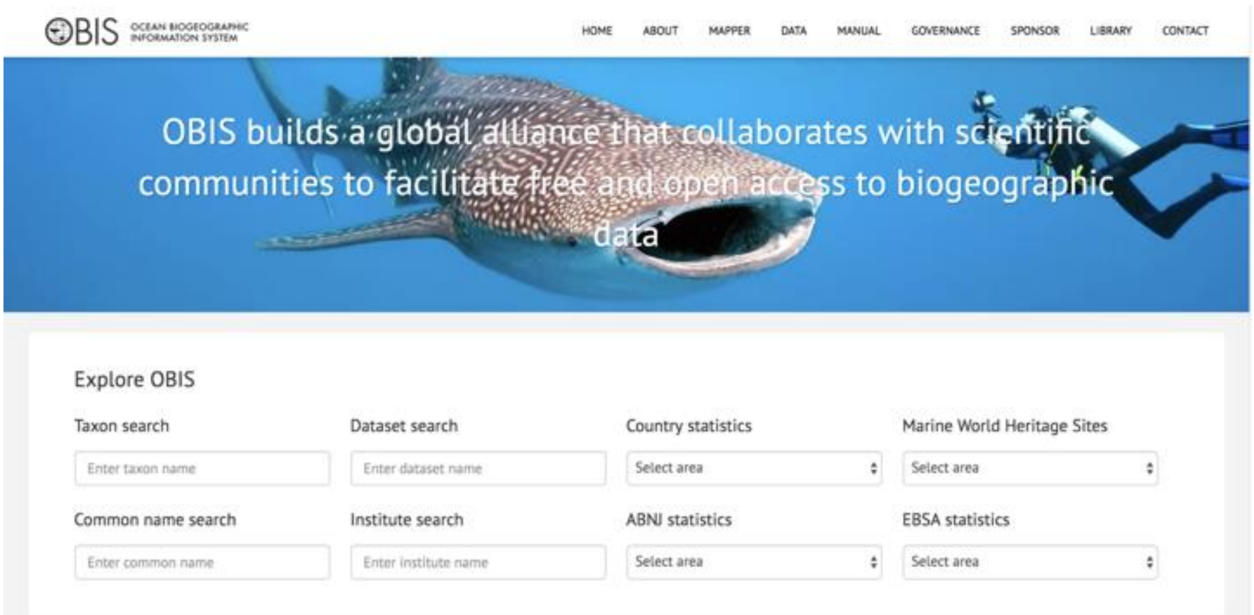

Figure 25: An example data query tool now developed for OBIS to allow for EBSA statistics to be queried directly.

Working with the OBIS development team we have assisted with the delivery of the EBSA location and boundary data to enable this new functionality (Figure 25), and see this new tool as an important component of this and future EBSA status and review processes. Figure 26 below depicts an automated data query identifying all open-access taxonomic data records held within the OBIS system for a selected EBSA. Due to the continuous growth and volatility of data holdings, developing a dynamic and self-updating tool is a significantly more useful outcome than a static snapshot of data holdings at any given time.

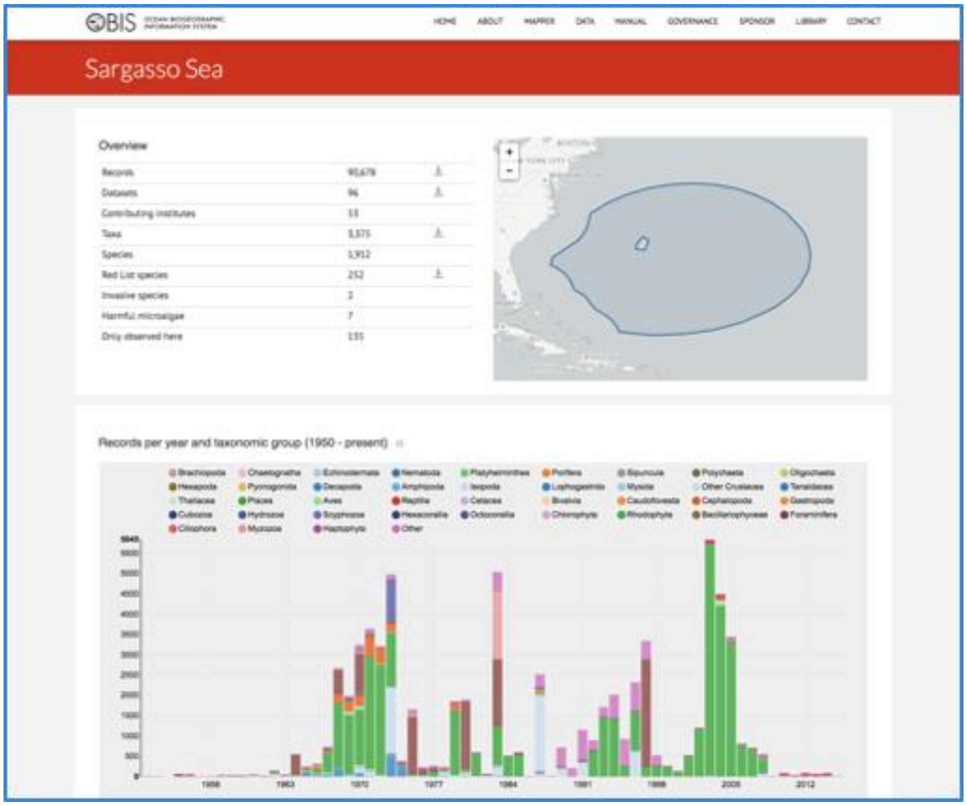

Figure 26: An example of an EBSA data query for the Sargasso Sea EBSA.

Bibliography

Ban, N.C., Bax, N.J., Gjerde, K.M., et al. (2014) Systematic conservation planning: a better recipe for managing the high seas for biodiversity conservation and sustainable use. *Conservation Letters* **7**, 41–54.

Bax, N.J., Cleary, J., Donnelly, B., Dunn, D.C., Dunstan, P.K., Fuller, M. and 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.

CBD (2013) Report of the North Pacific Regional Workshop to facilitate the description of Ecologically Or Biologically Significant Marine Areas. 25 February − 1 March 2013. Moscow, Russia UNEP/CBD/RW/EBSA/NP/1/4. Nairobi, Kenya.

Convention on Biological Diversity (2008) Decision adopted by the conference of the parties to the convention on biological diversity at its ninth meeting. Annex II. UNEP/CBD/COP/DEC/IX/20. Montreal, Canada.

Donald, P.F., Fishpool, L.D.C., Ajagbe, A., et al. (2018) Important Bird and Biodiversity Areas (IBAs): the development and characteristics of a global inventory of key sites for biodiversity. *Bird Conservation International*, 1–22.

Dunn, D.C., Ardron, J., Bax, N., et al. (2014) The Convention on Biological Diversity's Ecologically or Biologically Significant Areas: Origins, development, and current status. *Marine Policy* **49**, 137–145.

Dunn, D.C., Maxwell, S.M., Boustany, A.M. and Halpin, P.N. (2016) Dynamic ocean management increases the efficiency and efficacy of fisheries management. *Proceedings of the National Academy of Sciences* **113**, 668–673.

Freestone, D., Laffoley, D., Douvere, F. and Badman, T. (2016) *World Heritage in the High Seas: An Idea Whose Time Has Come*. UN Education, Scientific and Cultural Organization, Paris.

Harris, P.T., Macmillan-Lawler, M., Rupp, J. and Baker, E.K. (2014) Geomorphology of the oceans. *Marine Geology* **352**, 4–24.

Johnson, D., Davies, T., Bax, N., et al. (2019) The Global Ocean Biodiversity Initiative : Promoting scientific support for global ocean governance. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 1–8.

Johnson, D.E., Barrio Froján, C., Turner, P.J., et al. (2018) Reviewing the EBSA process: Improving on success. *Marine Policy* **88**, 75–85.

Longhurst, A.R. (2007) *Ecological geography of the sea*, 2nd edn. Elsevier, Amsterdam.

Maxwell, S.M., Hazen, E.L., Lewison, R.L., et al. (2015) Dynamic ocean management: Defining and conceptualizing real-time management of the ocean. *Marine Policy* **58**, 42–50.

Milner-Gulland, E.J., Fryxell, J. and Sinclair, A. eds (2011) *Animal migration: a synthesis*. Oxford University Press, Oxford, UK.

Schill, S.R., Raber, G.T., Roberts, J.J., Treml, E.A., Brenner, J. and Halpin, P.N. (2015) No Reef Is an Island: Integrating Coral Reef Connectivity Data into the Design of Regional-Scale Marine Protected Area Networks. *PloS One* **10**, e0144199.

Sherman, K. (1991) The large marine ecosystem concept: research and management strategy for living marine resources. *Ecological Applications* **1**, 349–360.

Spalding, M.D., Fox, H.E., Allen, G.R., et al. (2007) Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. *BioScience* **57**, 573.

Sutton, T.T., Clark, M.R. a., Dunn, D.C., et al. (2017) A global biogeographic classification of the mesopelagic zone. *Deep Sea Research Part I: Oceanographic Research Papers*.

Treml, E.A., Halpin, P.N., Urban, D.L. and Pratson, L.F. (2008) Modeling population connectivity by ocean currents, a graph-theoretic approach for marine conservation. *Landscape Ecology* **23**, 19–36.

Treml, E.A., Roberts, J.J., Chao, Y., Halpin, P.N., Possingham, H.P. and Riginos, C. (2012) Reproductive Output and Duration of the Pelagic Larval Stage Determine Seascape-Wide Connectivity of Marine Populations. *Integrative and Comparative Biology* **52**, 525–537.

UNESCO (2009) Global Open Oceans and Deep Seabed (GOODS) biogeographic classification. IOC Technical Series #84.