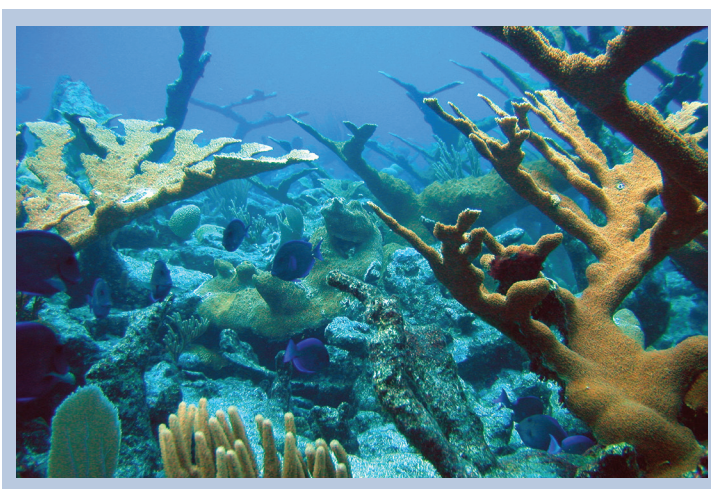
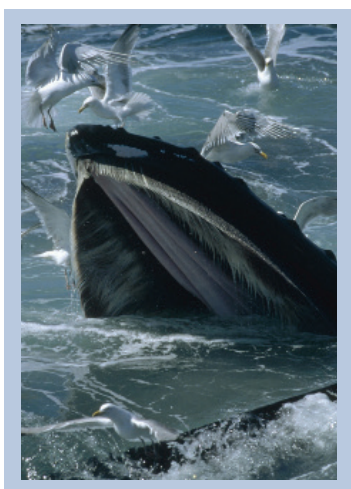
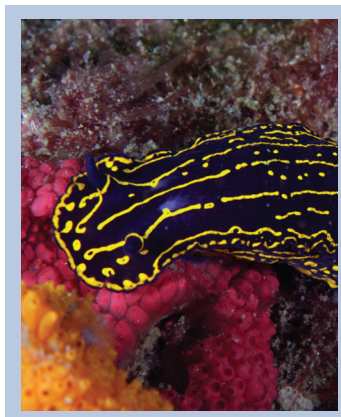
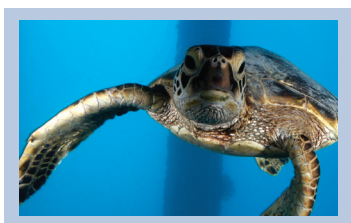


# Representativeness of Marine Protected Areas of the United States



January 2015

## **ABOUT THIS DOCUMENT**

This report is a product of the National Marine Protected Areas Center, part of NOAA's Office of National Marine Sanctuaries. It was written by Dr. Robert Brock, with contributions from: Jordan Gass; Hugo Selbie; Thomas Urban; and Dr. Charles Wahle of the MPA Center. Lauren Wenzel (MPA Center) edited the document and Matt McIntosh (NOAA/ONMS) designed the cover.

## **SUGGESTED CITATION:**

Brock, R. 2015. Representativeness of Marine Protected Areas of the United States. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Protected Areas Center, Silver Spring, MD.

## **REPORT AVAILABILITY**

Electronic copies of this report and detailed analyses for each ecoregion may be downloaded from the National Marine Protected Areas Center web site at <http://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/>

## **CONTACT:**

Dr. Robert J. Brock  
Marine Biologist  
National Marine Protected Areas Center  
1305 East-West Highway (N/NMS)  
Silver Spring, MD 20910-3278  
(301) 713-7285  
[Robert.Brock@noaa.gov](mailto:Robert.Brock@noaa.gov)

## **PHOTO CREDITS:**

Photos (left to right, top row): Greg McFall, NOAA; Tom Puchner, Flickr; Greg McFall, NOAA (middle row): USGS; Greg McFall, NOAA (bottom row): NOAA; NOAA



## Table of Contents

Executive Summary .....	i
Marine Protected Areas Representing Diverse Marine Ecosystems .....	1
Defining Ecoregions .....	2
The National System of MPAs .....	2
Methodology.....	3
Data Limitations .....	4
The National MPA Picture in U.S. Waters.....	5
Representativeness of Habitats .....	8
Representativeness of Fish and Marine Mammals .....	11
Representativeness of Birds, Invertebrates and Algae .....	12
Representativeness of Ecologically Important Areas .....	16
Conclusion .....	18
Assessment of Individual Marine Ecoregions .....	21
References .....	22
Annex A. Glossary .....	A-1

### Tables and Figures

Figure 1. Numbers and classification of MPAs found within the 19 ecoregions of the United States .....	2
Figure 2. CEC Marine Ecoregions of North America and the Non-CEC Arctic Basin, Great Lakes and Pacific Islands Ecoregions .....	3
Figure 3. Different types of MPAs depending upon their conservation focus and participation in the National System of MPAs .....	6
Table 1. Marine Protected Areas by Ecoregion .....	7
Table 2. Presence of Select Habitats within the National System of MPAs.....	9
Table 3. Percentages of Select Habitats in National System and Non-National System MPAs .....	10
Table 4. Presence of Select Fish Groups, Marine Mammals, Turtles and Threatened Species within the National System of MPAs .....	11

Table 5. Percentages of Fish, Marine Mammals and Sea Turtles in National System and Non-National System MPAs.....	13
Table 6. Presence of Select Bird, Invertebrate and Algal Groups within the National System of MPAs .	14
Table 7. Percentages of Select Bird, Invertebrate and Algal Groups in National System and Non-National System MPAs.....	15
Table 8. Presence of Ecologically Important Areas within the National System of MPAs .....	16
Table 9. Percentages of Ecologically Important Areas in National System and Non-National System MPAs .....	17
Table 10. Comparing All Marine Protected Areas and No-Take MPAs by Ecoregion .....	20

## **Executive Summary**

In 2000, President Clinton signed Executive Order (EO) 13158, directing the National Oceanic and Atmospheric Administration (NOAA), the Department of the Interior and other federal agencies to collaborate with states, territories and tribes to “develop a scientifically based, comprehensive national system of marine protected areas (MPAs) representing diverse U.S. marine ecosystems.” The EO further specifies that the national system should “preserve representative habitats in different geographic regions of the marine environment.” This report assesses two aspects of representativeness in MPAs in United States waters: (i) the presence of MPAs in the 19 marine ecoregions of U.S. waters; and, (ii) the presence and representativeness in those MPAs of major habitat types (e.g., corals, seagrass, rocky intertidal, submarine canyons), key natural resources (e.g., invertebrates, fish, marine mammals, birds), and ecologically important areas and processes (e.g., fish spawning, bird nesting and upwelling areas and feeding grounds). It assesses all MPAs in US waters, as well as the subset of MPAs that make up the National System of MPAs. The National System includes MPAs established and managed by agencies across all levels of government that have chosen to work together on shared conservation priorities.

This analysis of representativeness in 1,628 MPAs is based upon the presence/absence of major habitat types, key natural resources and ecologically important areas and processes. Nationally, MPAs are nominally representative of the major marine ecosystems of the U.S. with (a) 70% of select habitat types (e.g., beaches, corals, seagrass) found within MPAs of the 19 marine ecoregions and in at least one National System MPA in each ecoregion; (b) 82% of select birds, invertebrates and algal ecosystem features found within MPAs of the 19 marine ecoregions and in at least one National System MPA in each ecoregion; (c) 71% of select fish, marine mammal or sea turtle ecosystem features and Endangered Species Act (ESA) listed species found within MPAs of the 19 marine ecoregions and in at least one National System MPA in each ecoregion; and (d) 87% of select ecologically important ecosystem processes found within MPAs of the 19 marine ecoregions and in at least one National System MPA in each ecoregion.

This report also aims to indicate the strength of this representation (e.g., an ecosystem feature found in less than 1% of MPAs in an ecoregion versus more than 75%) by presenting “consumer report” graphics that indicate the relative prevalence of the presence of a resource (though not its spatial extent).

The results presented in this report do not alone signify that MPAs are either fully representative or operationally effective. Spatial distribution and abundance of key habitats, species and ecologically important areas within and around MPAs in each ecoregion, particularly in remote and poorly documented areas (e.g., regions and depths), are still generally lacking and are considered an information gap in many areas. While this analysis focuses on the presence of ecosystem features and processes within the national system and the broader set of MPAs within each ecoregion, the level of protection provided to these resources is critical to their effectiveness. Only two ecoregions out of 19 have more than one percent of their area in “no-take” reserves that prohibit all extractive uses – the South Florida/Bahamian Atlantic (4%) and the Hawaiian Archipelago (15%). This first level analysis of resource representativeness of both the National System of MPAs, and of all U.S. MPAs is intended to provide a useful baseline for future analyses of: the spatial coverage of habitats and resource groups within MPAs; levels of protection for resources of interest within MPAs; and opportunities to strengthen and expand the nation’s MPAs through enhanced planning and management.

Electronic copies of this report and detailed analyses for each ecoregion can be found at:  
<http://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/>

## **Marine Protected Areas Representing Diverse Marine Ecosystems**

In 2000, President Clinton signed Executive Order (EO) 13158, directing the National Oceanic and Atmospheric Administration (NOAA), the Department of the Interior and other federal agencies to collaborate with states, territories and tribes to *“develop a scientifically based, comprehensive national system of marine protected areas (MPAs) representing diverse U.S. marine ecosystems.”* The Order further specifies that the national system should *“preserve representative habitats in different geographic regions of the marine environment.”*

[The Framework for the National System of MPAs](#) was published by NOAA’s National Marine Protected Areas Center (MPA Center) in 2008 (a revised Framework is currently undergoing public review) and in 2013 the National System consisted of 412 MPA member sites. This analysis of MPAs aims to address two primary questions: 1) to what degree is the current collection of all MPAs in United States (U.S.) waters representative of diverse marine ecosystems, and 2) to what degree is the National System of MPAs representative of diverse marine ecosystems.

Representativeness, sometimes also termed “representativity,” has been recognized internationally as an important consideration in the design of MPA networks. At the Conference of the Parties (COP) to the Convention on Biological Diversity meeting in 2009 in the Azores, Portugal, the COP adopted scientific criteria for identifying ecological or biologically significant marine areas (EBSAs) in need of protection. These scientific criteria were developed at an Expert Workshop on EBSAs held in 2007 and included “representativity” as a required network property and component. The Azores Scientific Guidance notes that representativity is *“captured in a network when it consists of areas representing the different biogeographical subdivisions of the global oceans and regional seas that reasonably reflect the full range of ecosystems, including the biotic and habitat diversity of these ecosystems.”*

This analysis looks at two aspects of representativeness in America’s MPAs: (i) the presence of MPAs in the marine ecoregions of U.S. waters, as defined by the [Commission for Environmental Cooperation \(CEC\) of North America](#); and, (ii) the presence and representativeness in those MPAs of major habitat types, key natural resources, and ecologically important areas and processes. There is no single list of universally accepted defined U.S. marine ecosystems, although important habitats, species and ecosystem-drivers are well documented throughout much of the U.S. These regional and local descriptions have been used to assess whether MPAs generally, and those that are members of the national system, currently represent the wide diversity of habitats and species found throughout the U.S., as reflected in Executive Order 13158.

This analysis, conducted by the MPA Center, assessed whether various ecosystem features listed in the MPA Center’s Inventory are present in the different biogeographic marine areas of the nation and are found within MPAs (both national system members and not). The assessment that follows concludes that every major marine ecoregion in the U.S., and all of the key natural resource groups described in the MPA Inventory, are represented (i.e. contained) in



some MPA site in the National System, thus making the National System of MPAs as a whole nominally representative of the marine ecosystems of the U.S. The analysis is based on the MPA Inventory and the national system membership as of May 2013, but both the Inventory and the National System have been updated since that date.

### Defining Ecoregions

In 2002, the CEC assembled ecologists, marine biologists, geographers, planners and managers from the U.S., Mexico and Canada to assess North America’s marine biodiversity and identify ecoregions that describe the distinct physical, biological and oceanographic characteristics of each of these areas. Through this process, the CEC classified the ocean and coastal regions of North America into 24 marine ecoregions, 17 of which include U.S. marine waters (Figure 1). The MPA Center complemented this work by including in the MPA Inventory two ecoregions not covered by the CEC work – the Great Lakes and the Remote Pacific Islands - for a total of 19 U.S. marine ecoregions.

### The National System of MPAs

Executive Order 13158 directed the establishment of a national system of MPAs in order to connect and strengthen the dozens of federal, state, territorial, local and tribal MPA programs that comprise the current mosaic of protected places in the ocean and Great Lakes. The National System includes MPA sites, networks and systems established and managed by agencies across all levels of government that have chosen to work together on shared conservation priorities. Recognizing that an MPA system can be greater than the sum of its parts, these programs collaborate to strengthen the conservation of the nation’s natural and cultural marine heritage and represent its diverse ecosystems and resources. National System MPAs are managed independently, but work together, where appropriate, at the regional and national levels to achieve common objectives.

As of May 2013, the MPA Inventory (described below) contained 1,628 MPAs. Of these, 412 sites (25%) were members of the National System of MPAs; 671 (42%) were eligible to become National System members but had not yet joined; and 545 (33%) were not eligible to become National System members because they did not meet eligibility criteria such as having a management plan (Figure 2). The National System contains MPAs classified as natural heritage (i.e. established to

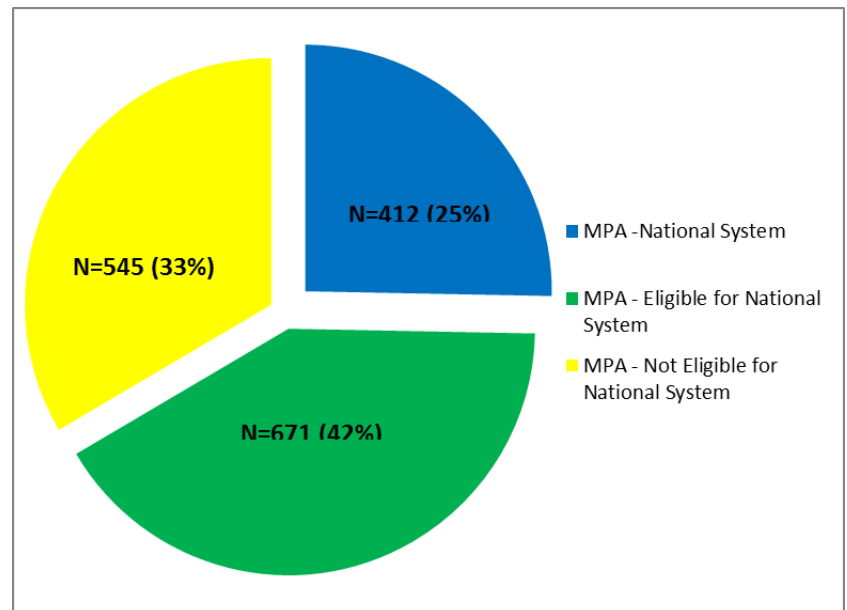


Figure 1. Numbers and classification of MPAs found within the 19 ecoregions of the United States.

protect biodiversity, communities, ecosystems, habitats), cultural heritage (i.e. established to protect the legacy of physical, historical evidence) and sustainable production (i.e. established to protect overfished stocks, by-catch species, essential fish habitats). The numbers reported include individual MPAs that come from all 17 of the CEC marine ecoregions as well as the two non-CEC ecoregions (Pacific Remote and Great Lakes).

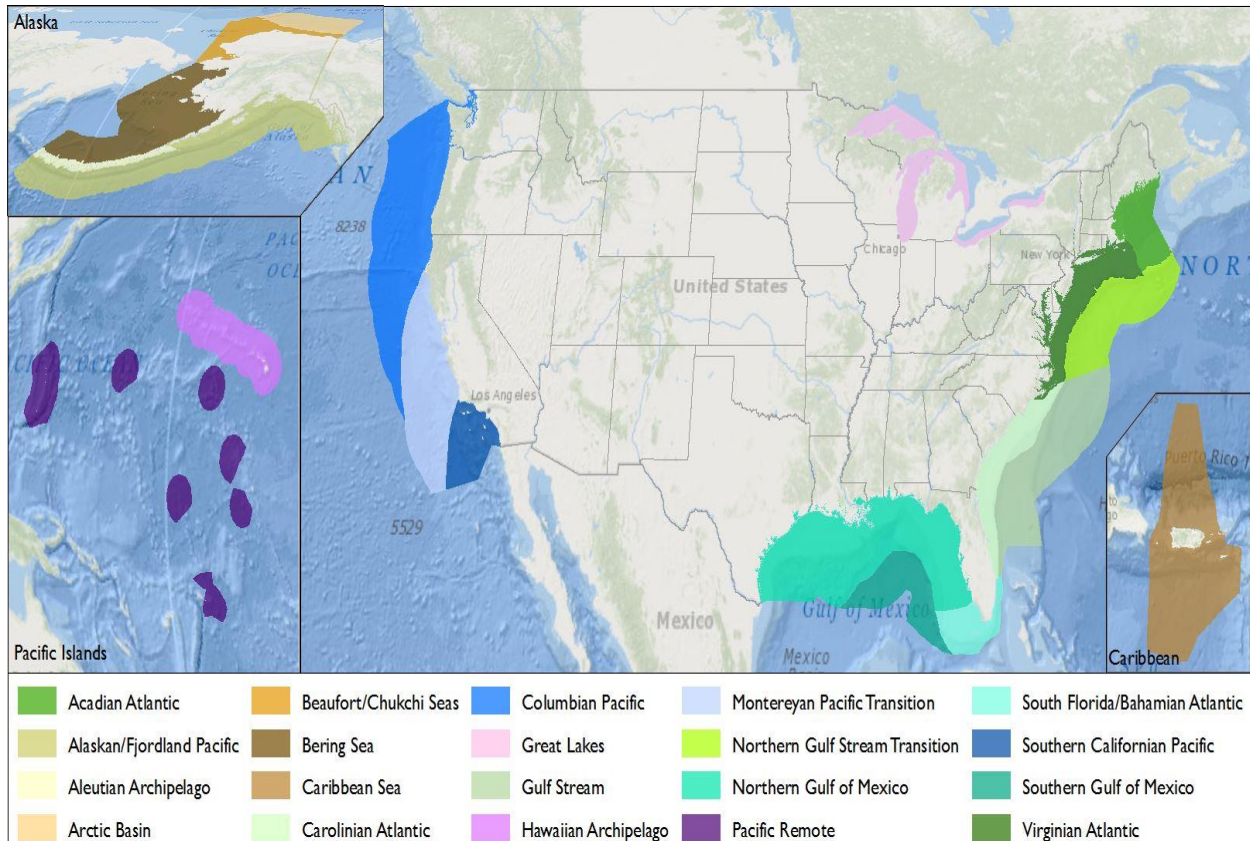


Figure 2. CEC Marine Ecoregions of North America and the Non-CEC Arctic Basin, Great Lakes and Pacific Islands Ecoregions

## **Methodology**

The National Oceanic and Atmospheric Administration’s (NOAA) National Marine Protected Areas Center (MPA Center) maintains a comprehensive [inventory](#) of the nation’s MPAs. Begun in 2001 and developed through collaborations with MPA agencies and programs, the Inventory reflects the best available information on U.S. MPA boundaries, purposes and management approaches. More recently, the Inventory has been augmented by data concerning the presence/absence of key ecological, physical and cultural resources of more than 1,700 MPAs, along with geospatial boundaries provided by the managing agencies. The ecological, physical and cultural data were collected by mining existing and readily available data from online repositories that held source documents, including but not limited to site descriptions, management plans, code of federal and state regulations, and scientific papers. These datasets were mined using standardized keyword searches to give each site equal weight regardless of MPA size or internet presence.



For each of the ecosystem features or processes, we provide summary tables illustrating whether it is present, and the degree to which it is present within the ecoregion's MPAs. Four scenarios are found (see box below). In addition, we highlight important patterns in presence and frequency of presence (i.e. in how many MPAs), or inferred gaps in our collective knowledge about the spatial distribution of key ecosystem features and processes and their protection by MPAs.

Presence/absence information alone does not, however, allow one to assess the strength of this representation (e.g., a natural resource found in one MPA versus found in twenty MPAs). Because of this, tables were developed representing National System and non-National System MPAs using "consumer reports" icons that illustrate the percentage of MPAs in which the ecosystem feature is present, using 25% increments. These icons illustrate whether a particular ecosystem feature is found in a negligible number of MPAs, or none (i.e. < 1% of the ecoregion's MPAs); just a few MPAs (1-25%); many MPAs (51-75%); or the great majority of MPAs (> 75%), and whether there appears to be more representation in the National System versus non-National System MPAs.

- Green – ecosystem feature or process is present<sup>1</sup> within an ecoregion and within a National System MPA in that ecoregion
- Yellow – ecosystem feature or process is present within the ecoregion, but only within an MPA that is not a member of the National System.
- Red – ecosystem feature or process is known or expected to be present within the ecoregion, based on the scientific literature and/or expert opinion, but is not present within an MPA in that ecoregion.
- Grey – ecosystem feature or process is not present within this ecoregion (i.e. not applicable)

### **Data Limitations**

What this assessment does identify the presence of ecosystem features and processes found within any of the nation's 1,628 MPAs as listed in the MPA Inventory. The MPA inventory does not note the spatial coverage of each ecosystem feature or process within the MPA (i.e. percent or area of the ecosystem feature within an MPA) because this information was not readily available for most ecosystem features and processes. For instance, this analysis illustrates if a particular ecosystem feature or process is present within any MPA (seagrass is present within Everglades National Park); it will not tell you the spatial extent of that natural resource within the MPA (amount of hectares of seagrass present within Everglades National Park). The Inventory contains basic information on the types of resource protection measures within the MPA (whether fishing is permitted, restricted or prohibited) but does not currently provide more detailed information on how that ecosystem feature or process is protected (no fishing, no anchoring, restriction of outboard motors), or what protective measures might be linked to the management of other specific ecosystem features or processes (coral habitats, bird nesting areas, etc.). While aimed at improving the quality and depth of the information available for

MPAs, this effort was not designed to characterize all the specific ecosystem features or processes within each site, but rather to summarize the resource groups present and the variety of management strategies applied to protect natural and cultural resources in MPAs at regional and national scales.

For each ecoregion, the MPA Center analyzed the presence and absence of identified ecosystem features or processes within that ecoregion's MPAs that are reported as, or are expected to be, present in the ecoregion based on the scientific literature on species and habitat distribution. Ecosystem features analyzed in this report can be grouped into habitats (e.g., beaches, corals, seagrass, seamounts), types of fish (e.g., anadromous, demersal, pelagic, migratory), marine mammals (e.g., cetaceans, pinnipeds, fissipeds, sirenians), birds (e.g., waterfowl, estuarine, seabirds), and invertebrates (e.g., subtidal, intertidal); processes include bird nesting, turtle nesting, fish spawning and marine mammal breeding.

This analysis is divided into the following subcategories:

- All U.S. MPAs (n= 1,628), including:
  - National System MPAs
  - MPAs that are eligible for, but are not yet members of, the National System (i.e. that meet the criteria of having defined management goals, objectives and a management plan)
  - MPAs that meet the Executive Order's definition but are not eligible for the National System because they do not meet the criteria for membership
- National System MPAs (n= 412) only

### **The National MPA Picture in U.S. Waters**

The MPA Inventory lists 1,628 MPAs throughout 19 ecoregions in U.S. waters as of May 2013. Of these, 412 (25%) were members of the National System. The U.S. has a classification system for MPAs depending upon their conservation focus, level of protection, permanence of protection, constancy of protection, and ecological scale of protection. As previously stated, the National System consists of natural heritage, cultural heritage and sustainable production MPAs. These MPAs can sometime overlap in their functions and protections (Figure 3). For instance, a cultural heritage MPA site may be protected for its historical significance, but is ecologically important as well. If certain activities are prohibited or restricted in a cultural heritage MPA (e.g., prohibiting all bottom contact gear such as trawling, longlining, pots), these restrictions may also offer significant protection to the area's ecosystem features such as habitats (e.g., corals, seagrass), and processes (e.g., fish spawning aggregation areas), thereby addressing the goals of a natural heritage MPA. The protections offered in the cultural heritage MPA may also overlap with the goals of a sustainable production MPA such as rebuilding overfished stocks, eliminating by-catch species or protecting essential fish habitat.

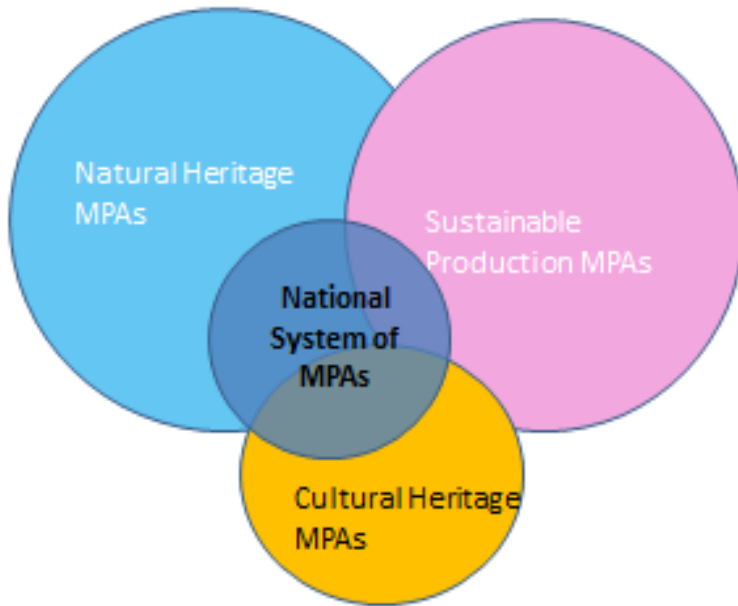


Figure 3. Different types of MPAs depending upon their conservation focus and participation in the National System of MPAs.

MPAs are not evenly distributed among the nation's ecoregions. They also vary significantly in numbers and size. The numbers of MPAs and the sizes of the marine ecoregions throughout the U.S. differ significantly and do not follow any pattern. Table 1 presents information pertaining to all MPAs throughout the 19 ecoregions, their sizes (km<sup>2</sup>), the percent of the ecoregion that is in an MPA, and whether the conservation focus of these MPAs are natural heritage, cultural heritage or sustainable production (i.e. fishery MPAs). Some highlights include:

- The marine ecoregions with the most MPAs are found along the Atlantic and Gulf coasts of the U.S. The Virginian Atlantic (n=333), Carolinian Atlantic (n=178) and Northern Gulf of Mexico (n=273) contain a total of 784 MPAs. Although representing only about 7% of the total marine ecoregion area of the U.S., these three ecoregions alone represent nearly half (48%) of the total MPAs of the U.S.;
- In contrast, the polar Bering Sea, Beaufort/ Chukchi Seas, Aleutian Archipelago, and Alaskan/Fjordland Pacific Ecoregions contain only 95 MPAs combined. Of these 95 MPAs, only seven are National System members. However, these four large ecoregions represent 28% of the entire U.S. marine ecoregion area but only 6% of the nation's total of MPAs;
- The ecoregion with the largest area in National System MPAs is the Hawaiian Archipelago (367,507 km<sup>2</sup>), home to the Papahānaumokuākea Marine National Monument and the Humpback Whale National Marine Sanctuary (as well as several other small MPAs);

Table 1. Marine Protected Areas by Ecoregion (as of May 2013)

Marine Ecoregion	Ecoregion Area (km <sup>2</sup> )	Total Number of MPAs	Total Area of all MPAs (km <sup>2</sup> )	% of Ecoregion in an MPA (includes large fishery MPAs)	Number of Natural and Cultural Heritage MPAs	Area of Natural and Cultural Heritage MPAs (km <sup>2</sup> )	% of Ecoregion in Natural Heritage and Cultural Heritage MPAs	Number of National System MPAs	Area of National System MPAs (km <sup>2</sup> )	% of Ecoregion in National System MPAs
Bering Sea	1,295,108	29	966,869	75	11	339,683	26	2	11,973	1
Beaufort/Chukchi Seas	275,171	5	855	0	5	855	0	2	461	0
Aleutian Archipelago	185,154	16	176,135	95	8	131,412	71	1	432	0
Alaskan/Fjordland Pacific	1,701,304	45	1,593,729	94	9	845,622	50	2	5,400	0
Southern Californian Pacific	103,337	91	43,696	42	71	4,830	5	67	4,829	5
Montereyan Pacific Transition	274,844	116	75,382	27	100	21,053	8	88	21,049	8
Columbian Pacific	445,705	110	272,227	61	79	10,581	2	39	10,205	2
Hawaiian Archipelago	2,486,316	59	435,731	18	21	372,732	15	12	367,507	15
Pacific Remote	3,380,210	47	500,788	15	41	500,759	15	20	46,726	1
South Florida/Bahamian Atlantic	83,743	92	46,413	55	85	14,262	17	10	13,329	16
Northern Gulf of Mexico	510,220	273	238,742	47	255	14,006	3	27	976	0
Southern Gulf of Mexico	142,963	1	22,028	15	0	0	0	0	0	0
Caribbean Sea	227,693	42	3,712	2	34	3,561	2	12	1,958	1
Acadian Atlantic	100,786	92	100,638	100	73	100,638	100	25	2,251	2
Virginian Atlantic	154,700	333	153,600	99	237	153,522	99	76	3,405	2
Northern Gulf Stream Transition	207,794	15	207,788	100	6	207,788	100	4	405	0
Gulf Stream	308,596	8	170,343	55	4	63,528	21	0	0	0
Carolinian Atlantic	127,881	178	124,980	98	157	86,354	68	19	673	1
Great Lakes	158,537	76	7,951	5	72	7,950	5	6	2,874	2
<b>Marine Ecoregion Totals =</b>	<b>12,170,063</b>	<b>1,628</b>	<b>5,141,606</b>	<b>1,003</b>	<b>1,268</b>	<b>2,879,135</b>	<b>AVE = 32%</b>	<b>412</b>	<b>494,452</b>	<b>3</b>

- The Acadian Atlantic, Virginian Atlantic, Carolinian Atlantic, Northern Gulf Stream Transition, Alaskan/Fjordland Pacific and Aleutian Archipelago Ecoregions all have over 90% of their area in some type of MPA. In these cases, these are usually very large MPAs with specific restrictions for the management of commercial fisheries or for marine mammal protection.

In summary, 48% of the total number of MPAs in the U.S. can be found in only 7% of the total U.S. MPA area and in contrast, 6% of the total numbers of MPAs in the polar ecoregions represent 28% of the entire MPA area of the U.S. These findings highlight the fact that there is a combination of a large number of small MPAs, and a small number of very large MPAs in the U.S.

### **Representativeness of Habitats**

Table 2 illustrates, for a range of major habitat types, whether they occur in the ecoregion and if so, whether they are located within a National System MPA (green), are located only within a non-National System MPA (yellow), are located within the ecoregion but are not found in any type of MPA (red), or are not present within that ecoregion (grey).

Restricted to relatively shallow tropical ecoregions, tropical coral reefs are widely recognized for their important ecological values. Tropical reefs are present within National System MPAs in each of the relevant ecoregions. Tropical corals are also reported to be found in the offshore, but relatively shallow, Southern Gulf of Mexico and Gulf Stream Ecoregions. These ecoregions do not have any MPAs that are members of the National System, but tropical corals are present in other MPAs in these ecoregions. Cold-water corals can be found at all depths in areas outside the tropics if certain conditions are met (e.g., hard substrates with water movement bringing food particles). Coldwater corals can also be found in the deeper waters (i.e. outside the photic zone) of tropical areas. Coral reefs, both tropical and temperate, exist in most ecoregions of the U.S. Coral reefs also exist in the offshore Gulf Stream Ecoregion. Beneath the warm Gulf Stream water, extensive deep-water coral banks consisting of primarily *Lophelia* form reefs near the shelf bank. The muddy waters of the Southern Gulf of Mexico Ecoregion are thought to contain more solitary individuals and less in reef-building corals. They are reported present in National System MPAs in just six of the 16 ecoregions where they occur. This information gap may be explained by the difficulty in exploring deep water areas to identify or confirm the presence of these deep-sea corals.

Seagrass is depth/light limited and is not present in the offshore, open ocean areas such as the Northern Gulf Stream Transition and Gulf Stream Ecoregions (indicated by the grey boxes in Table 2).

Kelp forests grow readily along the rocky shores of the Pacific coast (particularly *Macrocystis* sp.) where maximum water temperatures are < 20°C. These kelp habitats are not found along the sandy shores of the east coast of North America, although *Laminaria* may be found in the



Acadian Atlantic and northern reaches of the Virginian Atlantic ecoregions, but is not recorded in any of the MPAs in these ecoregions.

Table 2. Presence of select habitats within the National System of MPAs

CEC Marine Ecoregion	Rivers/Streams	Wetlands/Mudflats	Sand Dunes	Beach	Barrier Islands	Rocky Intertidal	Mangroves	Sea Grass	Coral Reefs (Temperate)	Coral Reefs (Tropical)	Rocky Reefs	Kelp & Algae	Seamounts/Pinnacles	Submarine canyons
Bering Sea	Green	Green	Grey	Green	Red	Green	Grey	Green	Green	Grey	Green	Green	Red	Red
Beaufort/Chukchi Seas	Green	Green	Grey	Green	Green	Red	Grey	Green	Red	Grey	Green	Green	Red	Red
Alaskan/Fjordland Pacific	Green	Green	Red	Green	Red	Green	Grey	Green	Red	Grey	Green	Green	Red	Red
Aleutian Archipelago	Green	Green	Grey	Green	Red	Green	Grey	Green	Red	Grey	Green	Green	Green	Grey
Southern Californian Pacific	Red	Red	Red	Green	Green	Green	Grey	Green	Green	Grey	Green	Green	Green	Green
Montereyan Pacific Transition	Green	Green	Green	Green	Red	Green	Grey	Green	Green	Grey	Green	Green	Green	Green
Columbian Pacific	Green	Green	Green	Green	Red	Green	Grey	Red	Red	Grey	Green	Green	Green	Red
Hawaiian Archipelago	Red	Red	Green	Red	Red	Red	Red	Green	Grey	Green	Green	Green	Green	Red
Pacific Remote	Red	Green	Grey	Green	Grey	Red	Red	Green	Red	Green	Grey	Green	Green	Green
South Florida/Bahamian Atlantic	Green	Green	Red	Green	Green	Grey	Green	Green	Red	Green	Grey	Green	Grey	Grey
Northern Gulf of Mexico	Green	Green	Green	Green	Green	Green	Yellow	Green	Red	Green	Red	Green	Grey	Grey
Southern Gulf of Mexico	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Green	Grey	Yellow	Yellow	Yellow
Caribbean Sea	Red	Green	Red	Green	Green	Green	Green	Green	Red	Green	Red	Green	Grey	Grey
Acadian Atlantic	Green	Green	Red	Green	Green	Green	Grey	Green	Yellow	Grey	Green	Green	Red	Red
Virginian Atlantic	Green	Green	Green	Green	Green	Green	Grey	Green	Green	Green	Red	Green	Red	Red
Northern Gulf Stream Transition	Grey	Green	Green	Green	Green	Green	Grey	Green	Green	Grey	Red	Red	Grey	Green
Gulf Stream	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Green	Grey	Yellow	Yellow	Red
Carolinian Atlantic	Green	Red	Green	Green	Green	Green	Red	Green	Green	Grey	Red	Green	Green	Grey
Great Lakes	Green	Green	Yellow	Green	Red	Green	Grey	Green	Green	Green	Red	Grey	Grey	Grey

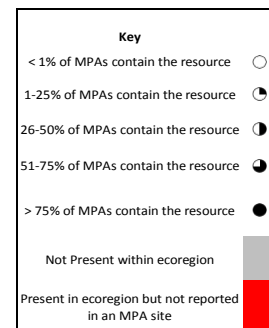
Present both within an ecoregion and within a National System MPA in that ecoregion  
 Present within the ecoregion, but only within an MPA that is not a member of the National System  
 Known or expected to be present within the ecoregion, based on scientific literature and/or expert opinion, but in not present within an MPA in that ecoregion  
 Not present within this ecoregion (e.g., not applicable)

Submarine canyons are found in deeper water along continental margins and along shelf-slope breaks, including waters off the Atlantic and Pacific coasts, as well as off Alaska and Hawaii. While submarine canyons were reported as present in National System MPAs in five ecoregions, they are thought to exist in seven more ecoregions where their presence was not reported. Remoteness and inaccessibility to submarine canyons typically requires substantial technological and other resources to confirm their locations and resources. It appears that deepwater features such as submarine canyons, seamounts and pinnacles are found in many more ecoregions than where they are reported as present. This data may be updated in the future when and if the MPAs are further explored with the use of this advanced technology.

Table 3 assesses how well (in percentages) represented these select ecosystems features (i.e. habitats) are in both National System and non-National System MPAs. For instance, rivers and streams are found in far greater percentages in National System MPAs compared to non-National System MPAs in the polar ecoregions. These natural resources are connected to wetlands and mudflats, which are similarly better represented in National System MPAs than

Table 3. Percentages of select habitats in national system and non-national system marine protected areas

Ecoregion	MPA Type	Rivers/Streams	Wetlands/Mudflats	Sand Dunes	Beach	Rock Interstitial	Mangrove Forests	Sea Grass	Coral Reef (Temperate)	Coral Reef (Tropical)	Rocky Reefs	Kelp Forest	Barrier Islands	Hydrothermal Vents/ Cold Seeps	Seamounts/Pinnacles	Submarine Canyons
Bering Sea	Non-National System MPA	○	■	■	○	○	■	○	○	○	○	○	■	■	○	■
	National System MPA	●	●	■	●	●	■	○	■	■	●	○	■	■	○	■
Beaufort/Chukchi Seas	Non-National System MPA	■	○	■	○	■	■	○	○	○	○	○	■	■	○	■
	National System MPA	●	●	■	○	○	■	○	■	○	○	○	■	■	○	■
Alaskan/Fjordland Pacific	Non-National System MPA	○	○	■	○	○	■	○	○	○	○	○	■	■	○	■
	National System MPA	○	●	■	○	○	■	○	■	○	○	○	■	■	○	■
Aleutian Archipelago	Non-National System MPA	■	■	■	○	○	■	○	○	○	○	○	■	■	○	■
	National System MPA	●	●	■	●	●	■	○	■	○	○	○	■	■	○	■
Southern Californian Pacific	Non-National System MPA	○	○	○	○	○	■	○	○	○	○	○	■	■	○	○
	National System MPA	■	○	○	○	○	■	○	○	○	○	○	■	■	○	○
Montereyan Pacific Transition	Non-National System MPA	○	○	○	○	○	■	○	○	○	○	○	■	■	○	○
	National System MPA	○	○	○	○	○	■	○	○	○	○	○	■	■	○	○
Columbian Pacific	Non-National System MPA	○	○	■	○	○	■	○	○	○	○	○	■	■	○	○
	National System MPA	○	○	○	○	○	■	○	○	○	○	○	■	■	○	○
Hawaiian Archipelago	Non-National System MPA	■	○	○	○	○	■	○	○	○	○	○	■	■	○	○
	National System MPA	■	○	○	○	○	■	○	○	○	○	○	■	■	○	○
Pacific Remote	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
South Florida/Bahamian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Northern Gulf of Mexico	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Southern Gulf of Mexico	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Caribbean Sea	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Acadian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Virginian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Northern Gulf Stream Transition	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Gulf Stream	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Carolinian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Great Lakes	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○







non-National System MPAs in this ecoregion. No other habitat resources appear to be disproportionately represented (National System versus non-National System MPAs) in any of the other ecoregions.

### Representativeness of Fish and Marine Mammals

Table 4 summarizes the presence and absence of select ecosystem features such as fish groups, marine mammals and sea turtles. Pinnipeds (e.g., seals, sea lions, elephant seals and walrus) are primarily confined to polar, subpolar and temperate areas and are common in many ecoregions in colder waters (e.g., Alaskan/Fjordland Pacific, Montereyan Pacific Transition). The most obvious exception to this is the Hawaiian monk seal (*Monachus schauinslandi*), found throughout the Hawaiian Archipelago Ecoregion.

Table 4. Presence of Select Fish Groups, Marine Mammals, Turtles and Threatened Species within the National System of MPAs

CEC Marine Ecoregion	Anadromous Fish	Estuarine Fish	Reef Fish	Fish (Demersal) (Groundfish)	Fish (Coastal Pelagic)	Fish (Migratory)	Fish (Fresh Demersal)	Deepwater (> 200m) Species	Cetaceans	Pinnipeds	Fissipeds	Sirenia	Sea Turtles	ESA Listed Species
Bering Sea														
Beaufort/ Chukchi Seas														
Alaskan/Fjordland Pacific														
Aleutian Archipelago														
Southern Californian Pacific														
Montereyan Pacific Transition														
Columbian Pacific														
Hawaiian Archipelago														
Pacific Remote														
South Florida/ Bahamian Atlantic														
Northern Gulf of Mexico														
Southern Gulf of Mexico														
Caribbean Sea														
Acadian Atlantic														
Virginian Atlantic														
Northern Gulf Stream Transition														
Gulf Stream														
Carolinian Atlantic														
Great Lakes														

 Present both within an ecoregion and within a National System MPA in that ecoregion  
 Present within the ecoregion, but only within an MPA that is not a member of the National System  
 Known or expected to be present within the ecoregion, based on scientific literature and/or expert opinion, but is not present within an MPA in that ecoregion  
 Not present within this ecoregion (e.g., not applicable)

Fissipeds (e.g., sea otters, polar bears) are found along the Alaskan and Pacific coasts and are noted as present in all of these ecoregions. Sirenia (e.g., manatees) have a poor tolerance for cold water and are found throughout the warmer Southeast and Gulf coasts as well as in the Caribbean, and are reported in these ecoregions. Sea turtles have a wide geographic range and the various species are found throughout both warm and temperate waters. Sea turtles were not reported in MPAs in the Southern Californian and Columbian Pacific Ecoregions along the Pacific coast, although green and leatherback sea turtles, in particular, have been seen in California, indicating a potential information gap. The only ecoregions where sea turtles are not present are in Alaskan waters.

Reef fish (which aggregate around coral reefs), demersal fish (fish that predominantly live on or near the bottom of the sea) and deep-water fish (those that live at > 200m depth) are widely present in several ecoregions where they are not present in any MPAs – highlighted by the red boxes in Table 4 (and in all tables). This indicates a potential gap in the representativeness of MPAs in these ecoregions for these ecosystem features.

Table 5 assesses how well (in percentages) represented these select ecosystem features (e.g., fish and marine mammal groups) are found in both National System and non-National System MPAs. No obvious discernable patterns emerge from any national versus non-national MPAs comparisons.

### **Representativeness of Birds, Invertebrates and Algae**

Table 6 summarizes the presence and absence of various groups of birds, invertebrates and algae within MPAs by ecoregion. The bird groups are labeled according to where they derive their energy from and/or where they rest during stopovers (e.g., freshwater, estuarine, open ocean); invertebrates and algae are labeled according to where they can be found (e.g., intertidal versus subtidal).

Seabird distribution is very broad, including coastlines as well as the open ocean. Seabirds are found within MPAs in every ecoregion of the U.S. Waterfowl derive the majority of their energy from freshwater sources, and are thus not typically found in offshore, open ocean areas such as in the Northern Gulf Stream Transition Ecoregion. It is thought, however, that waterfowl may migrate seaward from the Gulf Coast's wetlands and may be present in the Southern Gulf of Mexico, though they are not reported as present in any of this ecoregion's MPAs. Estuarine birds, which thrive along coastal rivers and streams, are found in all marine ecoregions except the offshore Northern Gulf Stream Transition Ecoregion. All of the MPAs in this ecoregion (n=15) consist of deep-water canyons and offshore fishery restricted zones. "Other birds" refer to species such as opportunistic bird of prey raptors (e.g., eagles, hawks) with life history characteristics that do not fit neatly into distinct categories (i.e. deriving energy from freshwater, estuarine, or oceanic sources). Ecoregions where "other" bird groups are present, but not found in MPAs (shown in red), are the offshore Southern Gulf of Mexico and Gulf Stream, indicating a potential gap where the MPAs in this ecoregion are not representative for this species group.

Table 5. Percentages of of fish, marine mammals and sea turtles in national system and non-national system marine protected areas

Ecoregion	MPA Type	Anadromous Fish	Estuarine Fish	Reef Fish	Fish (Demersal Groundfish)	Fish (Coastal Pelagic)	Fish (Migratory)	Fish (fresh Demersal)	Deepwater (> 200m) Species	Cetaceans	Pinnipeds	Fissipeds	Sirenia	Sea Turtles
Bering Sea	Non-National System MPA	●	○	■	●	○	○	○	■	○	○	○	○	○
	National System MPA	●	●	■	●	●	○	○	■	●	●	●	○	○
Beaufort/Chukchi Seas	Non-National System MPA	○	○	■	●	○	○	○	■	○	○	○	○	○
	National System MPA	●	●	■	●	●	○	○	■	●	●	●	○	○
Alaskan/Fjordland Pacific	Non-National System MPA	●	○	■	●	○	○	○	■	○	○	○	○	○
	National System MPA	●	○	■	●	●	○	○	■	●	●	●	○	○
Aleutian Archipelago	Non-National System MPA	●	○	■	●	○	○	○	■	○	○	○	○	○
	National System MPA	●	●	■	●	●	○	○	■	●	●	●	○	○
Southern Californian Pacific	Non-National System MPA	○	○	■	●	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	■	●	○	○	○	○	○	○	○	○	○
Montereyan Pacific Transition	Non-National System MPA	○	○	■	●	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	■	●	○	○	○	○	○	○	○	○	○
Columbian Pacific	Non-National System MPA	○	○	■	●	○	○	○	○	○	○	○	○	○
	National System MPA	●	○	■	●	○	○	○	○	○	○	○	○	○
Hawaiian Archipelago	Non-National System MPA	■	○	●	○	○	○	○	○	○	○	○	○	○
	National System MPA	■	○	●	○	○	○	○	○	○	○	○	○	○
Pacific Remote	Non-National System MPA	○	○	●	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	●	○	○	○	○	○	○	○	○	○	○
South Florida/Bahamian Atlantic	Non-National System MPA	○	○	●	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	●	○	○	○	○	○	○	○	○	○	○
Northern Gulf of Mexico	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
Southern Gulf of Mexico	Non-National System MPA	■	○	●	○	○	○	○	○	○	○	○	○	○
	National System MPA	■	○	●	○	○	○	○	○	○	○	○	○	○
Caribbean Sea	Non-National System MPA	■	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	■	○	○	○	○	○	○	○	○	○	○	○	○
Acadian Atlantic	Non-National System MPA	○	○	■	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	■	○	○	○	○	○	○	○	○	○	○
Virginian Atlantic	Non-National System MPA	○	○	■	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	■	○	○	○	○	○	○	○	○	○	○
Northern Gulf Stream Transition	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	■	○	○	○	○	○	○	○	○	○	○	○	○
Gulf Stream	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
Carolinian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
Great Lakes	Non-National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○	○	○	○	○	○

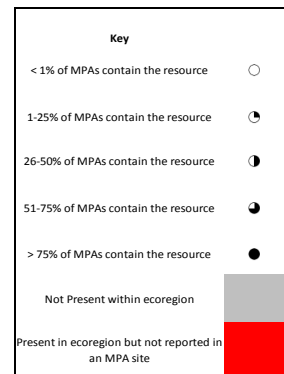




Table 6. Presence of select Bird, Invertebrate and Algal Groups within the National System of MPAs

CEC Marine Ecoregion	Seabirds	Waterfowl	Estuarine Birds	Other Birds	Subtidal Inverts	Rocky Intertidal Inverts	Subtidal Benthic Algae	Rocky Intertidal Algae
Bering Sea	Green	Green	Green	Green	Green	Green	Green	Green
Beaufort/Chukchi Seas	Green	Green	Green	Green	Green	Green	Green	Green
Alaskan/Fjordland Pacific	Green	Green	Green	Green	Green	Green	Green	Green
Aleutian Archipelago	Green	Green	Green	Green	Green	Green	Green	Green
Southern Californian Pacific	Green	Green	Green	Green	Green	Green	Green	Green
Montereyan Pacific Transition	Green	Green	Green	Green	Green	Green	Green	Green
Columbian Pacific	Green	Green	Green	Green	Green	Green	Green	Green
Hawaiian Archipelago	Green	Green	Green	Green	Green	Green	Green	Green
Pacific Remote	Green	Green	Green	Green	Green	Red	Green	Red
South Florida/Bahamian Atlantic	Green	Green	Green	Green	Green	Red	Green	Red
Northern Gulf of Mexico	Green	Green	Green	Green	Green	Yellow	Green	Red
Southern Gulf of Mexico	Yellow	Red	Yellow	Red	Yellow	Grey	Red	Grey
Caribbean Sea	Green	Green	Green	Green	Green	Green	Green	Red
Acadian Atlantic	Green	Green	Green	Green	Green	Green	Green	Green
Virginian Atlantic	Green	Green	Green	Green	Green	Green	Green	Green
Northern Gulf Stream Transition	Yellow	Green	Yellow	Yellow	Red	Grey	Grey	Grey
Gulf Stream	Yellow	Green	Yellow	Yellow	Yellow	Grey	Grey	Grey
Carolinian Atlantic	Green	Green	Green	Green	Green	Green	Green	Red
Great Lakes	Green	Green	Green	Green	Green	Grey	Yellow	Grey

	Present both within an ecoregion and within a National System MPA in that ecoregion
	Present within the ecoregion, but only within an MPA that is not a member of the National System
	Known or expected to be present within the ecoregion, based on scientific literature and/or expert opinion, but is not present within an MPA in that ecoregion
	Not present within this ecoregion (e.g., not applicable)

Rocky intertidal habitat can be found in several ecoregions (Table 2). Rocky intertidal invertebrates and algae are found between mean low and mean high tide, and are not found in offshore, open ocean MPAs such as those in the Northern Gulf Stream Transition, Gulf Stream, and Southern Gulf of Mexico Ecoregions, except opportunistically on emergent man-made structures (e.g., oil rigs) and floating marine debris. Rocky intertidal algae are found in national system MPAs in only six ecoregions, although they are present in an additional six ecoregions. Rocky intertidal invertebrates are found in most of the nation’s marine ecoregions, but are not found in any MPA in five ecoregions. These gaps in coverage may be due to lack of data for the MPAs in these ecoregions.

Subtidal algae and invertebrates are submerged most of the time, and exposed only under extreme low tide events. These resources are widely distributed along the nation’s coastlines and are present in the National System MPAs in 13 and 14 of the nation’s marine ecoregions, respectively. Subtidal invertebrates are reported to be found in MPAs that are not part of the National System in both the Southern Gulf of Mexico (n=1) and the Gulf Stream (n=6) Ecoregions. Several of the species comprising this group are recreationally and/or commercially valuable (such as crabs, shrimp and lobsters).

All of the bird groups appear to be well represented in all of the ecoregions, the National System MPAs slightly more represented (found in a higher percentage of MPAs) versus the non-National System MPAs in the polar ecoregions (Table 7). This is also true for the intertidal and subtidal algal and invertebrate groups in the polar ecoregions as well.

Table 7. Percentages of select bird, invertebrate and algal groups in national system and non-national system MPAs

Ecoregion	MPA Type	Seabirds	Waterfowl	Estuarine Birds	Other Birds	Subtidal Invertebrates	Rocky Intertidal Inverts	Subtidal Benthic Algae	Rocky Intertidal Algae
Bering Sea	Non-National System MPA	●	◐	◐	◐	●	◐	◐	◐
	National System MPA	●	●	●	●	●	●	●	●
Beaufort/Chukchi Seas	Non-National System MPA	◐	◐	◐	●	◐	■	◐	■
	National System MPA	●	●	●	●	●	◐	●	◐
Alaskan/Fjordland Pacific	Non-National System MPA	◐	◐	◐	◐	●	◐	◐	◐
	National System MPA	●	●	●	●	◐	●	●	◐
Aleutian Archipelago	Non-National System MPA	◐	◐	◐	◐	●	◐	◐	◐
	National System MPA	●	●	●	●	●	●	●	●
Southern Californian Pacific	Non-National System MPA	◐	◐	◐	◐	◐	◐	◐	◐
	National System MPA	◐	◐	◐	◐	●	◐	◐	◐
Montereyan Pacific Transition	Non-National System MPA	◐	◐	◐	◐	◐	◐	◐	■
	National System MPA	◐	◐	●	◐	●	◐	◐	◐
Columbian Pacific	Non-National System MPA	◐	◐	◐	◐	◐	◐	◐	◐
	National System MPA	●	◐	●	◐	●	◐	◐	◐
Hawaiian Archipelago	Non-National System MPA	◐	◐	◐	◐	◐	◐	◐	■
	National System MPA	◐	◐	◐	◐	●	◐	◐	■
Pacific Remote	Non-National System MPA	◐	○	◐	◐	●	◐	■	■
	National System MPA	◐	◐	◐	◐	●	◐	■	■
South Florida/Bahamian Atlantic	Non-National System MPA	●	◐	●	●	●	◐	■	■
	National System MPA	●	●	●	●	●	◐	■	■
Northern Gulf of Mexico	Non-National System MPA	●	◐	●	●	◐	◐	○	■
	National System MPA	●	●	●	●	●	●	○	■
Southern Gulf of Mexico	Non-National System MPA	●	■	●	■	●	■	■	■
	National System MPA	◐	◐	◐	◐	◐	◐	◐	■
Caribbean Sea	Non-National System MPA	◐	◐	◐	◐	◐	◐	■	■
	National System MPA	●	◐	◐	◐	●	◐	◐	■
Acadian Atlantic	Non-National System MPA	◐	◐	◐	◐	◐	◐	◐	◐
	National System MPA	◐	◐	◐	◐	◐	◐	◐	◐
Virginian Atlantic	Non-National System MPA	◐	◐	◐	◐	◐	◐	○	■
	National System MPA	◐	◐	◐	◐	◐	◐	◐	◐
Northern Gulf Stream Transition	Non-National System MPA	◐	◐	◐	◐	■	■	■	■
	National System MPA	■	■	■	■	■	■	■	■
Gulf Stream	Non-National System MPA	◐	◐	◐	◐	◐	■	■	■
	National System MPA	◐	◐	◐	◐	◐	◐	◐	■
Carolinian Atlantic	Non-National System MPA	◐	◐	◐	◐	◐	◐	○	■
	National System MPA	◐	◐	●	●	●	◐	◐	■
Great Lakes	Non-National System MPA	◐	◐	◐	◐	◐	◐	■	■
	National System MPA	◐	●	●	●	◐	■	■	■

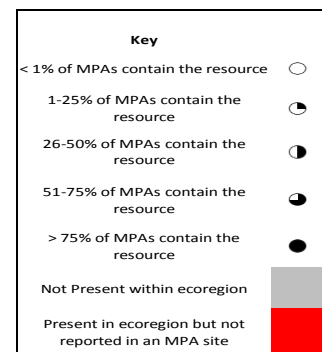


Table 8. Presence of Ecologically Important Areas within the National System of MPAs

CEC Marine Ecoregion	Nursery Grounds	Fish Spawning Area	Bird Nesting Habitat	Turtle Nesting	Marine Mammal Breeding	Marine Mammal Haulout	Bird Migratory Area
Bering Sea	Present	Present	Present	Not Present	Present	Present	Present
Beaufort/ Chukchi Seas	Present	Present	Present	Not Present	Present	Present	Present
Alaskan/Fjordland Pacific	Present	Present	Present	Not Present	Present	Present	Present
Aleutian Archipelago	Present	Present	Present	Not Present	Present	Present	Present
Southern Californian Pacific	Present	Present	Present	Not Present	Present	Present	Present
Montereyan Pacific Transition	Present	Present	Present	Not Present	Present	Present	Present
Columbian Pacific	Present	Present	Present	Not Present	Present	Present	Present
Hawaiian Archipelago	Present	Present	Present	Present	Present	Present	Present
Pacific Remote	Present	Present	Present	Present	Present	Present	Present
South Florida/Bahamian Atlantic	Present	Present	Present	Present	Not Present	Not Present	Present
Northern Gulf of Mexico	Present	Present	Present	Present	Not Present	Not Present	Present
Southern Gulf of Mexico	Present	Present	Not Present	Not Present	Present	Not Present	Present
Caribbean Sea	Present	Present	Present	Present	Present	Not Present	Present
Acadian Atlantic	Present	Present	Present	Present	Present	Present	Present
Virginian Atlantic	Present	Present	Present	Present	Present	Present	Present
Northern Gulf Stream Transition	Present	Present	Not Present	Not Present	Present	Not Present	Present
Gulf Stream	Present	Present	Not Present	Not Present	Present	Not Present	Present
Carolinian Atlantic	Present	Present	Present	Present	Present	Not Present	Present
Great Lakes	Present	Present	Present	Not Present	Present	Not Present	Present

	Present both within an ecoregion and within a National System MPA in that ecoregion
	Present within the ecoregion, but only within an MPA that is not a member of the National System
	Known or expected to be present within the ecoregion, based on scientific literature and/or expert opinion, but in not present within an MPA in that ecoregion
	Not present within this ecoregion (e.g., not applicable)

### Representativeness of Ecologically Important Areas

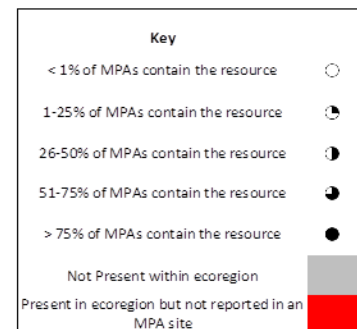
Table 8 summarizes the presence of ecologically important areas such as spawning, nesting, resting and feeding areas in protected areas throughout U.S. waters. Nursery grounds are areas where young fish can feed, take refuge and grow, and are located primarily in coastal areas. Bird nesting habitat is present in all ecoregions with a coastal component. The only MPAs lacking bird nesting habitat are the offshore Northern Gulf Stream Transition and Gulf Stream Ecoregions where nesting cannot occur because they do not include land. Marine mammal haul-outs are generally used by pinnipeds and fissipeds, and include rocks and isolated beaches, as well as islands in temperate and polar waters (with the exception of the Hawaiian Archipelago, home to the monk seal). Pinnipeds and fissipeds haulout areas are not found in offshore areas or the South Florida/Bahamian Atlantic and Caribbean ecoregions.

Mangroves are sub-tropical and tropical species and are found in four ecoregions. Mangroves are carbon sequesters and act as buffers to wave energy. Their prop roots act as refuge for many juvenile fish species, and their branches as habitat for roosting birds.

Table 9 assesses how well (in percentages) very important ecological processes (species spawning, nesting, resting, feeding) are found in both National System and non-National System MPAs. No obvious discernable patterns emerge from any national versus non-national MPAs comparisons, with both groups reporting > 25% presence of these processes found in the ecoregion’s MPAs.

Table 9. Percentages of Ecologically Important Areas in national system and non-national system MPAs

Ecoregion	MPA Type	Nursery Grounds	Fish Spawning Area	Bird Nesting Habitat	Turtle Nesting	Marine Mammal Breeding	Marine Mammal Haulout	Bird Migratory Area	ESA Listed Species
Bering Sea	Non-National System MPA	○	○	○		○	○	○	○
	National System MPA	●	●	●		●	●	●	●
Beaufort/Chukchi Seas	Non-National System MPA	■	■	○		■	○	○	○
	National System MPA	●	●	●		●	●	●	●
Alaskan/Fjordland Pacific	Non-National System MPA	○	○	○		○	○	○	○
	National System MPA	○	○	○		●	●	●	●
Aleutian Archipelago	Non-National System MPA	○	○	○		○	○	○	○
	National System MPA	●	●	●		●	●	●	●
Southern Californian Pacific	Non-National System MPA	○	○	○		○	○	○	●
	National System MPA	○	○	○		○	○	○	○
Montereyan Pacific Transition	Non-National System MPA	○	○	○		○	○	○	○
	National System MPA	○	○	○		○	○	○	○
Columbian Pacific	Non-National System MPA	○	○	○		○	○	○	○
	National System MPA	○	○	○		○	○	○	○
Hawaiian Archipelago	Non-National System MPA	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	■	○	○	○	○
Pacific Remote	Non-National System MPA	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○
South Florida/Bahamian Atlantic	Non-National System MPA	○	○	○	○	○		○	○
	National System MPA	●	○	○	○	○		○	○
Northern Gulf of Mexico	Non-National System MPA	○	○	○	○	○		○	○
	National System MPA	●	○	○	○	○		○	○
Southern Gulf of Mexico	Non-National System MPA	■	○			■		■	○
	National System MPA	○	○	○	○	○		○	○
Caribbean Sea	Non-National System MPA	■	○	○	○	■		○	○
	National System MPA	○	○	○	○	○		○	○
Acadian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○
Virginian Atlantic	Non-National System MPA	○	○	○	○	○	○	○	○
	National System MPA	○	○	○	○	○	○	○	○
Northern Gulf Stream Transition	Non-National System MPA	○	○			○		○	○
	National System MPA	■	■			■		■	○
Gulf Stream	Non-National System MPA	○	○			○		○	○
	National System MPA	○	○			○		○	○
Carolinian Atlantic	Non-National System MPA	○	○	○	○	○		○	○
	National System MPA	○	○	○	○	○		○	○
Great Lakes	Non-National System MPA	○	○	○		○		○	○
	National System MPA	○	○	○		○		○	○



## Conclusions

Executive Order 13158 directs federal agencies, working with state, tribal and territorial partners, to create a “comprehensive national system of MPAs *representing* diverse U.S. marine ecosystems” that will “*preserve* representative habitats in different geographic regions of the marine environment”. Begun in 2008, the National System comprised 412 voluntary member sites of many types and sizes in 2013. This preliminary analysis demonstrates that the full spectrum of the 19 recognized Marine Ecoregions in U.S. waters are, in fact, nominally represented by the current National System of MPAs. Moreover, National System MPAs encompass many of the key ecosystem features (e.g., habitat types, marine species) and ecologically important processes within each ecoregion. Consider:

- Nationally, 70% of habitat types found within the 19 marine ecoregions of the U.S. are found in at least one National System MPA in each ecoregion.
- Nationally, 82% of birds, invertebrates and algal ecosystem features found within the 19 marine ecoregions of the U.S. are found in at least one National System MPA in each ecoregion.
- Nationally, 71% of fish, marine mammal or sea turtle ecosystem features and Endangered Species Act (ESA) listed species found within the 19 marine ecoregions of the U.S. are found in at least one National System MPA in each ecoregion.
- Nationally, 87% of ecologically important ecosystem processes found within the 19 marine ecoregions of the U.S. are found in at least one National System MPA in each ecoregion.

If one eliminates the ecoregions with no National System MPAs (Gulf Stream and Southern Gulf of Mexico), the representativeness of the National System is even stronger (by an additional 5-10%). No one ecoregion appears to be clearly more or less representative overall than the others in all ecosystem features.

While encouraging, these results do not alone signify that the current National System is either fully representative or operationally effective. For example, this initial analysis highlights critical gaps in our collective understanding about the structure and function of U.S. marine ecosystems and about the nature and efficacy of our efforts to manage them spatially with MPAs. Creating that knowledge base and capacity will require additional investment into:

- The spatial distribution and abundance of key habitats, species and ecologically important areas within and around MPAs in each ecoregion, particularly in remote and poorly documented areas (e.g., regions and depths)
- The patterns, drivers and impacts of the full range of current and emerging ocean uses, and environmental change
- The nature, scope and effectiveness of existing spatial management measures used by U.S. MPAs to address threats to the protected ecosystems and the services they provide.

The summary tables also indicate potential gaps in either representation of important ecosystem features within National System MPAs (indicated by yellow boxes) or data gaps



(indicated by red boxes). For example, coldwater corals, submarine canyons, reef fish and rocky intertidal algae and invertebrates are not recorded as present in National System MPAs in many of the ecoregions where they are present. While this potential gap may be the result of a lack of data for these marine resources in MPAs, they indicate a need for a deeper look into the presence and spatial distribution of these natural resources in order to be able to provide appropriate protection.

This analysis was intended to be a first look at the representativeness of habitats, species groups and ecologically important areas, based on their presence in each of the nation's 19 marine ecoregions. Key priorities for future analysis, to provide a more comprehensive picture of effective representation include:

- **Better understanding of the spatial distribution of key habitat types within MPAs.** We lack spatial data on the national distribution of many habitats and species groups. It is also important to look at ecoregions in the same geographical area, potentially leading to more regional spatial analysis and understanding. However, a spatial analysis of the best available data on habitat and species groups and the degree to which they are located within the nation's MPAs would be very helpful in highlighting potential management and data gaps. Assessing protection of key habitat types relies on knowing where and to what degree the habitat exists and implementing appropriate protective measures to these areas.
- **Better understanding of the management tools currently used within MPAs to protect key habitats and species.** The location of habitat and species within an MPA does not, by itself, tell us how well those resources are being protected. MPAs span a wide range of management approaches, from multiple use to "no-take" reserves. Moreover, they employ a complex set of diverse regulations to protect specific resources. For example, some MPAs prohibit anchoring or bottom contact gear (e.g., bottom trawls, pots, longlines) in areas where seagrass and coral are found in order to avoid being damaged (e.g., uprooting seagrass, breaking off branching coral) by these gear types. The site specific and often complex nature of MPA regulations makes a national or regional synthesis of resource protection difficult. The data on "no take" marine reserves in this report is a first step toward this analysis. As seen in Table 10, marine reserves constitute less than one percent of the total MPA area in most marine ecoregions.
- **Better knowledge and understanding of deep-sea resources within MPAs.** As one goes offshore into deep water, there is generally a greater lack of knowledge of the resources present in these MPAs. The remoteness and inaccessibility of offshore MPAs typically requires substantial technological and other resources to confirm their locations and resources. Submarine canyons, for example, were reported as present in only four National System MPAs of the 12 ecoregions where they occur. Coldwater corals, usually found in deep water, were not reported in eight ecoregions although they are known to occur there. Subsequently, no reef fish associated with coldwater corals and sponges were reported in MPAs in the polar and west coast ecoregions although they are known to occur in each.

Table 10. Comparing All Marine Protected Areas and No-Take MPAs by Ecoregion (as of May 2013)

Marine Ecoregion	Ecoregion Area (km <sup>2</sup> )	Total Number of MPAs	Total Area of all MPAs (km <sup>2</sup> )	Number of "No-Take" MPAs	Total Area of "No-Take" MPAs (km <sup>2</sup> )	% of Ecoregion in a "No-Take" MPA
Bering Sea	1,295,108	29	966,869	1	745	< 1
Beaufort/Chukchi Seas	275,171	5	855	0	0	0
Aleutian Archipelago	185,154	16	176,135	0	0	< 1
Alaskan/Fjordland Pacific	1,701,304	45	1,593,729	0	0	< 1
Southern Californian Pacific	103,337	91	43,696	32	1,111	1
Montereyan Pacific Transition	274,844	116	75,382	33	514	< 1
Columbian Pacific	445,705	110	272,227	24	87	< 1
Hawaiian Archipelago	2,486,316	59	435,731	13	363,701	15
Pacific Remote	3,380,210	47	500,788	17	46,726	1
South Florida/Bahamian Atlantic	83,743	92	46,413	7	3,347	4
Northern Gulf of Mexico	510,220	273	238,742	10	319	< 1
Southern Gulf of Mexico	142,963	1	22,028	0	0	0
Caribbean Sea	227,693	42	3,712	18	3,357	1
Acadian Atlantic	100,786	92	100,638	1	1	< 1
Virginian Atlantic	154,700	333	153,600	8	59	< 1
Northern Gulf Stream Transition	207,794	15	207,788	2	427	< 1
Gulf Stream	308,596	8	170,343	0	0	0
Carolinian Atlantic	127,881	178	124,980	12	235	< 1
Great Lakes	158,537	76	7,951	15	3.84	0
<b>Marine Ecoregion Totals =</b>	<b>12,170,063</b>	<b>1,628</b>	<b>5,141,606</b>	<b>193</b>	<b>420,633</b>	

- **Better knowledge and understanding of intertidal and subtidal invertebrates and algae within MPAs.** Intertidal algae and invertebrates appear to represent an area lacking information. Rocky intertidal algae, for example, was not reported in eight ecoregions although it is known to occur there.
- **Distinction between merely being present in an MPA versus receiving protection.** While this analysis focuses on the presence of ecosystem features and processes within the national system and the broader set of MPAs within each ecoregion, the level of protection provided to these resources is critical to their effectiveness. Only two ecoregions out of 19 have more than one percent of their area in “no-take” reserves that prohibit all extractive uses – the South Florida/Bahamian Atlantic (4%) and the Hawaiian Archipelago (15%) (Table 10). In the former, Florida Keys National Marine Sanctuary contains several no-take reserves of varying sizes (e.g., Tortugas Ecological Reserves). In the Hawaiian Archipelago, the Papahānaumokuākea Marine National Monument contributes nearly all of the no-take area in this ecoregion, representing a significant amount of full protection to each of these two ecoregions, respectively.

Evolving the U.S. National System of MPAs from being simply “representative” to truly protecting what we treasure most about our nation’s oceans will require both knowledge and action. Leveraging the enhanced ecosystem and MPA information articulated above, we can engage partners and stakeholders in collaborative local and regional efforts to identify gaps in protection for important and valued ocean areas, and to collectively design appropriate MPA management strategies to fill them, as envisioned by the U.S. policy on MPAs. It is hoped that this first level analysis of resource representativeness of both the National System of MPAs, and of all U.S. MPAs, will provide a useful baseline for future analyses of the spatial coverage of resource groups within MPAs; level of protection for resources of interest within MPAs; and opportunities to strengthen and expand the nation’s MPAs through enhanced planning and management.

### **Assessment of Individual Marine Ecoregions**

In addition to assessing any trends exhibited nationally, the MPA Center has provided a description and analysis of the representativeness of ecosystem features and processes in each of the 17 CEC marine ecoregions. These materials provide additional detail supporting this national level analysis. They also provide information on the degree to which resource protection is replicated at more than one MPA in each ecoregion. Replication is an important component of MPA network development, and is present in varying degrees across U.S. ecoregions. These regional analyses are available at:

<http://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/>

## **References**

Convention of Biological Diversity (CBD). 2009. Azores Scientific Criteria and Guidance for identifying ecologically or biologically significant marine areas and designing representative networks of marine protected areas in open ocean waters and deep sea habitats. United Nations Environment Programme, IUCN, CBD.

<http://www.cbd.int/marine/doc/azores-brochure-en.pdf>

National Marine Protected Areas Center, 2013. Marine Protected Areas Inventory.

<http://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/>

Wilkinson, T., E. Wilken, J. Bezaury-Creel, T. Hourigan, T. Agardy, H. Herrmann, L. Janishevski, C. Madden, L. Morgan and M. Padilla. 2009. Marine Ecoregions of North America. Commission for Environmental Cooperation. Montreal, Canada. 200pp.

## Annex A. Glossary of Terms

**Barrier Islands** – long offshore dynamic accumulations of sand lying parallel to coastal areas

**Beach** – deposits of sandy/rocky shore habitat up to mean high high-water

**Benthic Algae** – marine plants such as turf algae, kelps and other forms of seaweeds that are predominantly subtidal species

**Benthic Invertebrates (Mobile/Sessile)** - invertebrates that predominantly inhabit the subtidal benthos and are able to freely move about

**Birds (Estuarine/Coastal)** - birds that derive most of their energy from the coastal or wetland environment (e.g., whimbrels, sandpipers, clapper rails)

**Birds (Seabird)** - birds that derive most of their energy from the offshore marine environment (e.g., cormorants, petrels, seagulls)

**Bird migratory area** – area used by migrating birds as a migration stop over (e.g., habitat specifically mentioned as having this function, such as coastal wetlands, bays, cliffs, dunes)

**Bird nesting habitat** – areas used by birds as typical nesting habitat (e.g., dunes, wetlands, mangroves)

**Birds (Other)** - birds not already listed as waterfowl, estuarine or seabirds (e.g., raptors)

**Birds (Waterfowl)** - birds that derive most of their energy from the freshwater aquatic environment (e.g., ducks)

**Coastal Marine Reptile** - marine reptiles not included in sea turtle definition (e.g., crocodiles, sea snakes, marine lizards)

**Coral Reef** - areas that are dominated by biota associated with the structures created by hermatypic (reef-building) corals. This includes biology defined through hermatypic corals, and other biota that contribute to reef building, such as dead corals and calcareous algae

**Corals (Temperate)** - cold water corals (shallow or deepwater) lacking the symbiotic zooxanthellae algae

**Corals (Tropical)** - tropical corals possess the symbiotic zooxanthellae algae

**Deepwater Species** - fish species that live below 200-meters

**Endangered Species (ESA) listed** – a species at risk of extinction (due to, for example, human activities, climate change, natural perturbations)

**Essential fish habitat (EFH) conservation area** –an area essential to fish spawning, breeding, feeding, or growing to maturity as defined by the Magnuson-Stevens Fisheries Conservation and Management Act and identified by NOAA and regional fishery management councils

**Fish (Anadromous)** - fish that spawn in fresh water but spend the majority of their life in the ocean (e.g., salmon, trout, sturgeon)

**Fish (Coastal Pelagic)** - fish that live predominantly in the upper levels of the coastal ocean (e.g., sardines, mackerels)

**Fish (Demersal) or Fish (Groundfish)** - fish that predominantly live on or near the bottom of the sea (e.g., flatfish, skates, rockfish). The term “demersal” is used in East Coast fisheries; the term “groundfish” is used in West Coast fisheries.

**Fish (Estuarine/Coastal Marine)** - fish that live predominantly in estuarine, or freshwater coastal marsh or brackish water (e.g., killifish)

**Fish (Freshwater Demersal)** - fish that predominantly live on or near the bottom in freshwater areas (e.g., Sciaenids such as freshwater drums, croakers, hardheads)

**Fish (Freshwater Pelagic)** - fish that live predominantly in the upper levels of freshwater areas (e.g., trout)

**Fish (Highly Migratory Marine Species)** - fish that migrate across ocean basins (e.g., sharks, billfish)

**Fish (Reef fish, tropical)** - fish that live predominantly on or near coral reefs (e.g., moray eels, damselfish, parrotfish)

**Fish spawning area** – area where fish aggregate to spawn during part or all of the year (e.g., seamounts, banks, coral reefs, intertidal wetlands)

**Hydrothermal Vents/Cold Seeps** –some type of ocean fissure in the sea floor that gives rise to chemosynthetic organisms

**Hydrothermal Vent Species** – species associated with hydrothermal vent ecosystems, including chemosynthetic fauna

**Kelp and Algae** - brown algae (e.g., kelp and sargassum)

**Kelp Forest** – underwater areas with a high density of kelp

**Mangrove Forests** – areas of tropical evergreen red, black or white mangrove trees or shrubs having stilt-like intertwining prop roots (e.g., red mangroves), root-like aerial projections (e.g., black mangroves) or efficient salt glands (e.g., white mangroves) growing from below the highest tide levels in estuaries and along coasts up to higher ground that experiences periodic saltwater flooding

**Marine Mammal Breeding area** – areas used by marine mammals for breeding and birthing (e.g., Ano Nuevo State Park, CA. used by elephant seals)

**Marine Mammals (Cetaceans)** - marine mammals from the Order Cetacea (e.g., whales, dolphins)

**Marine Mammals (Fissipeds)** - marine mammals from the Order Fissipeda (e.g., sea otters, polar bears)

**Marine Mammals (Pinnipeds)** - marine mammals from the Order Pinnipeda (e.g., seals, sea lions)

**Marine Mammals (Sirenia)** – marine mammals from the Order Sirenia (e.g., manatees)

**Marine mammal haul out** - the place where marine mammals crawl or pull themselves out of the water and onto land or ice for resting, breeding and/or birthing

**Nursery grounds** – areas used by juvenile species as habitat (e.g., mangrove roots, intertidal wetlands, seagrasses, coral reefs)

**Oceanographic Fronts** – frontal oceanic event; linear features formed at the conjunction of two or more water masses with different properties

**Oceanographic Gyres** – gyre oceanic event; a large system of rotating ocean currents resulting from prevailing wind forcing, buoyancy forcing, and Coriolis acceleration; occurs at the ocean basin scale

**Oyster/Shellfish beds** - locations where shellfish species (e.g., oysters, clams, mussels) occupy more than 50% of an area

**Rivers/Streams** - freshwater input such as flowing water entering or passing through MPA boundaries

**Rocky Intertidal** - areas of the marine nearshore subsystem between mean lower low water (MLLW) and the maximum shoreward extent of tidal inundation, the extreme high water of spring tides

**Rocky Intertidal (Algae)** - turf algae, kelps and other forms of seaweeds that inhabit the intertidal zone where rock habitat is present

**Rocky Intertidal Invertebrates (mobile/sessile)** - invertebrates that predominantly inhabit the intertidal region

**Rocky Reefs** - rocky reef habitat in the marine nearshore subsystem; includes all waters and bottom extending from the supratidal zone at the coastal land margin to the 30-meter depth contour

**Sand Dunes** - active accumulation of sand formed by wind or wave action with some elevation occurring on a beach or further inland within site boundaries

**Sea Turtle** - sea turtles from the Order Chelonia and Testudines (e.g., hawksbill, green, leatherback)

**Seagrass** –individual flowering plants from one of four plant families (Posidoniaceae, Zosteraceae, Hydrocharitaceae, or Cymodoceaceae) which grow in marine, fully-saline environments.)

**Seagrass habitat** – accumulation of individual seagrass species together forming a larger functioning habitat

**Seamounts/Pinnacles** - elevation of the seafloor, rising 1,000 meters or higher. Seamounts are made by extrusion of lavas piped upward in stages from sources within the Earth's mantle to vents on the seafloor. Seamounts may be discrete, arranged in a linear or random grouping, or connected at their bases and aligned along a ridge or rise

**Submarine Canyons** –a valley in the seafloor formed by fracture or by erosional processes

**Turtle nesting area** – area used by sea turtles for nesting

**Upwelling Zones** –upwardly directed current resulting from the divergence of water masses or from movement of surface water away from the coast

**Wetlands/Mudflats** - areas characterized by erect, rooted, emergent herbaceous hydrophytes (e.g., plants growing in/around water), excluding mosses and lichens, where vegetation is present for most of the growing season in most years; coastal wetlands that form when mud is deposited by tides or rivers