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Marine Protected Areas and the Chesapeake Bay

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Chapter 1: Executive Summary

A marine protected area (MPA) is defined by the National Oceanic and Atmospheric Administration (NOAA) as a defined region designated and managed for the long-term conservation of marine resources, ecosystem services, or cultural heritage. Marine areas are protected for many reasons including not only the preservation of aquatic animals and their habitats, but also the preservation of maritime cultural heritage sites such as shipwrecks. There are several types of MPAs which vary by the government agency overseeing them, their designation pathway, and the level of restrictions they impose on the resources within. Within this report we explore in more detail federal-level MPA designations (national marine sanctuaries, national wildlife refuges, national marine monuments, and national parks). However, it should be noted that there are State-level designations and spatial management regulations, as well as sub-types under the national park system (e.g. national seashores, national battlefields, national preserves, national recreation areas) that may also protect marine resources.

The designation of an area as an MPA comes with economic and social considerations. Oftentimes, coastal communities rely on resources within an MPA for their livelihood; however, while designation does not always equate to restriction of harvest, the perception of MPAs by maritime business owners is often distrustful and negative. While it is true that some MPAs have a negative history with the public,

there is evidence of MPA designation being beneficial to communities from resulting booms in the tourism industry and increased fishing yields outside the borders of a restrictive MPA. Overall, designation requires engaging *all* stakeholders to develop a sustainable management strategy for the resources aimed to be protected and the communities who are affected most by the designation.

In this report we use the Chesapeake Bay area as a case study to look at the efforts to manage resources using MPAs regionally. We compare the current state of marine living resources to their historic populations, the considerations for utilizing spatial management, the reasons marine areas are protected, and some current efforts of marine protection in the Chesapeake Bay. The Chesapeake Bay has 1 national marine sanctuary, 9 national wildlife refuges, 11 natural area preserves, 2 national estuarine research reserves, 1 wildlife management area, and 1 state park that protects marine areas (based on 2023 NOAA MPA inventory dataset). While not technically MPAs under NOAA's definition, the Chesapeake Bay also hosts submerged aquatic vegetation (SAV) protection zones, a seasonal blue crab spawning sanctuary, and oyster reef sanctuaries. Since the Chesapeake Bay has been the center of the largest oyster restoration project in the world, we have explored oyster sanctuaries in more depth within this report.

Chapter 2: Purpose and Methodology

2.1 Purpose Statement

The goal of this report is to jumpstart the authors' understanding of the scientific, social, and political considerations of protected marine environments, explore the applicability of Chesapeake Bay MPAs, and serve as a reference for others wanting to learn more about MPAs nationally and within the Chesapeake Bay. The information in this report is supplemented by summaries of informational interviews with MPA and natural resource management professionals as well as documented sentiments from commercial and recreational fishermen, and others that work in maritime industry.

2.2 Approach

The first phase of this project acted as a three month exploratory phase, which allowed the team to gather a wide net of information by keeping research interests broad and open-ended. After the first team meeting, a flexible roadmap was developed along with short and long term goals that were of interest. The long term goals of the project were to answer the following questions (see [Appendix C](#) for answers):

1. What is the process of and entities involved in designation of an MPA?
2. How to navigate the political, social, economic and other challenges associated with designation of protected areas?
3. What are the laws and regulations regarding fishing at the different levels of MPA designation?
4. How Urban planning and Public access can be a major consideration in the protected area field and sustainable development as populations continue to grow?
5. How does an MPA get designated with the nearby communities in mind? How do you ensure livelihoods are not harmed and ensure local voices are incorporated into the decision making process?
6. How does enforcement of MPAs work?

Following the introductory meetings, the team referenced these goals and the roadmap was adapted. This report serves as a repository of the information learned by the team during their exploratory phase.

A total of 6 informational interviews were conducted with experts in MPAs and sanctuaries, oyster reefs, federal land protection, and wildlife ecology. When paired with a literature review, these interviews provided additional perspectives on how MPAs can serve their intended purpose, and what protection status and regulation can look like in different geographical areas.

Chapter 3: Introduction

3.1 | *What are Marine Protected Areas?*

MPAs can be an effective management strategy to relieve marine ecosystems and cultural heritage sites from stressors, such as human impacts or changing environmental conditions ([Kelleher & Phillips, 1999](#); [Wells et al. 2016](#)). An MPA, defined by NOAA, is a “defined region designated and managed for the long-term conservation of marine resources, ecosystem services, or cultural heritage” ([NOAA Ocean Exploration, 2021](#)).

MPAs are commonly established across the globe to aid the replenishment of fisheries, conserve threatened species and/or habitats, and maintain ecosystem benefits ([Kelleher & Phillips, 1999](#); [Wells et al. 2016](#)). However, the first National Marine Sanctuary in the United States was established in 1975 for the protection of an important cultural resource, the shipwreck of the USS Monitor. The USS Monitor National Marine Sanctuary has since opened the door for the designation of 17 other national marine sanctuaries in the United States, including the Malloes Bay-Potomac River National Marine Sanctuary, the only national marine sanctuary within the Chesapeake Bay watershed ([National Marine Sanctuary, n.d-e](#)).

3.1.1 | Differences Between Terrestrial Protected Areas

It is important to note that MPAs are not just underwater national parks. MPAs fall under several different types of designations depending on the resources being protected and the agencies that manage the site. While a few MPAs are jointly designated as national parks, that is not the case for all. This larger system of designations, called the National System of Marine Protected Areas, was established in 2000 through a presidential executive order requiring the establishment of a national MPA center underneath NOAA’s jurisdiction who manages the overall designation and implementation processes ([National Ocean Service, 2015](#)). This executive order emphasizes the uniqueness of MPAs and the importance of their existence beyond the use of other

federally designated protection systems like national parks or refuges.

Each type of designation under the MPA framework can involve different agencies and levels of government and may differ in what type of resource is prioritized for protection. While there are 18 national marine sanctuaries within the United States, there are over 1,700 MPAs that range from full protection with high restrictions (no-take zones) to lower protection with varying regulations for recreational and commercial activity ([National Ocean Service, 2015](#)).

3.1.2 | Types of Marine Protected Areas & Designation Processes

All MPAs focus on using resource management tactics to protect or conserve an area of historical, cultural or ecological importance ([National Ocean Service, 2015](#)). However, differences in the type of protection exist in what restrictions are enforced, what resources are prioritized, and/or what governing bodies are involved. Four different types of federal-level MPAs are highlighted below, followed by the steps for designation each one must follow.

National Marine Sanctuary

Designating a site as a national marine sanctuary ensures more responsible resource conservation practices. While this is a federal designation, NOAA requires the formation of a sanctuary advisory council, made up of local experts who actively engage the community and govern management actions within the sanctuary ([National Marine Sanctuaries, n.d-d](#)).

National marine sanctuary sites have a wide range of reasons for being designated and don’t need to be wildlife conservation-oriented. To be protected, a site must demonstrate national significance, which may include: living resources in need of protection; historical, archaeological, or cultural resources in need of preservation; and/or the potential for educational or recreational value ([National Marine Sanctuaries, n.d-c](#)).

National Marine Sanctuaries are designated through the National Marine Sanctuary Act, passed in 1972. This legislation gives the Secretary of Commerce the authority to designate marine sanctuaries in areas that are deemed nationally significant through the presence of environmental, cultural, historical, or recreational resources ([National Marine Sanctuaries, n.d.-c](#)). This authorization often follows extensive work by NOAA through a scoping process to determine if the necessary criteria is met. This scoping process includes extensive engagement with stakeholders from a range of backgrounds, whether they be government agency partners, tribes, organizations, or community members. Potential sites can also be nominated by the local community itself.

After the scoping process is complete and a site is determined to meet the necessary criteria, NOAA drafts documentation for designation, which includes management plans, proposed regulations and restrictions, and environmental impact analyses. Additionally, each sanctuary's advisory council actively assists in the development of these documents. Outside of the advisory councils, there is a public feedback period where NOAA can make appropriate changes based on public recommendations. Ultimately, a final designation document is created and published where final regulations are put into place following congressional review and approval ([National Marine Sanctuaries, n.d.-b](#)).

National Parks

As of 2023, 45 MPAs under [NOAA's inventory](#) are also named within the National Park Service's (NPS) National Park System; 10 of these are designated as National Parks ([Marine Protected Areas of the United States, n.d.-b](#)). National parks are created through congressional direction and have varying levels of restriction, as defined in the specific language of the congressional act designating each park. Some parks may have multiple levels of restrictions within the park itself, such as a no-fishing zone within a specific radius of a broader recreational area.

To start the process of designating a national park, congressional direction is required. NPS does not have the authority to start the process on their own

account; however, once the direction is given, they can begin a "Special Resource Study" (SRS) ([National Park Service, n.d. -a](#)). These studies evaluate an area for the criteria needed to become a national park: (1) it possesses nationally significant resources; (2) it would be a suitable and (3) feasible addition to the Park System; and (4) it would require NPS to manage and protect, as opposed to alternative federal, state, or local government agencies or private organizations ([National Park Service, n.d. -b](#)).

If the SRS determines that an area meets all requirements, the NPS will begin drafting documentation for designation, similar to NOAA's role with national marine sanctuaries. Public engagement with stakeholders is held throughout the process, and the public can comment on the draft report before it is finalized and submitted to Congress. The last step requires the Secretary of the Interior to introduce the study to Congress for final approval and designation.

Marine National Monuments

Marine national monuments fall under broader national monument regulations, which extend to land-based sites; a national monument that sits in ocean waters is considered a marine national monument. All national monuments, regardless of their geological features, require designation from the president through the Antiquities Act, which is often coupled with direction towards a specific federal agency to manage the site ([Palmer, 2015](#)). Marine national monuments often have the highest level of restriction for fishing and other human activity that could impact its living and cultural resources ([Palmer, 2015](#)).

All national monuments require presidential action through the 1906 Antiquities Act which gives the president the authority to establish national monuments on federal lands. This designation comes with strict enforcement of management actions for preservation and/or protection of the resource that is being prioritized, whether it be natural, historical, cultural, etc. The means of preservation, management, and enforcement are based on the language of the specific presidential proclamation for each national monument, with more details specified

later in the management plan. Similarly, the length of time it could take to complete designation also relies on the language of the authorization and what steps the president has taken to create it. Since this process comes from a presidential proclamation, there is no legal requirement to include a public feedback process, however some form of public engagement often occurs. Some national marine monuments engage the public via review of management plans and regulations, and many monuments have Advisory Councils much like national marine sanctuaries. ([National Marine Sanctuary Foundation, 2020](#); [National Oceanic and Atmospheric Administration, n.d.-f](#)).

National Wildlife Refuges

National Wildlife Refuges are managed by the U.S. Fish & Wildlife Service (FWS) under their National Wildlife Refuge System and primarily focus on preserving habitat and wildlife through various conservation management strategies. Refuges that are also MPAs are co-managed with NOAA and other participating agencies unique to each site. There are currently over 150 MPAs within the National Wildlife Refuge System, each ranging in the type of governmental management (whether it be a federal, state, local, or tribal MPA) ([Marine Areas, Islands and Coasts, n.d.](#)). Additionally, five marine national monuments are included in the refuge system ([U.S. Fish & Wildlife Service, n.d.-a](#)). These refuges often have a focus on conserving fish and other wildlife habitat for threatened or endangered species, though some are designated for historical or cultural resources ([O'Brien, n.d.](#)).

Unlike the NPS, the FWS has the authority to begin studies to determine if a site could be designated as a national wildlife refuge, and does not require congressional direction to start the process. The National Wildlife Refuge System Administration Act, passed in 1966 and amended over time, provides the FWS the authority to begin this process, administer the National Wildlife Refuge System, and determine the necessary processes to create management plans for the refuges ([U.S. Fish & Wildlife Service, n.d.-b](#)). If a site satisfies the requirements, specifically the need for conserving habitat for fish and wildlife in the area, then the process continues similarly to that

of a national park ([Nardi, 2025](#)). Being a lead federal agency, the FWS is mandated to follow National Environmental Policy Act (NEPA) requirements to involve the public in most major decisions ([National Environmental Policy Act | U.S. Fish & Wildlife Service, n.d.](#)). In the case of designating new refuges, the public is engaged through participating in public feedback sessions of Environmental Assessments (EAs) or Environmental Impact Statements (EISs) ([National Environmental Policy Act | U.S. Fish & Wildlife Service, n.d.](#); [516 DM 8 Managing the NEPA Process - U.S. Fish and Wildlife Service, 2024](#)). A designation document detailing management strategies and restrictions is then drafted and is sent for congressional approval and action.

3.1.4 | Why are Marine Areas Protected?

Marine protected areas are designated for multiple reasons, including preservation of living resources and habitats, as well as preservation of historic and cultural resources. Designation has also shown to directly benefit the economies of nearby communities in addition to the fishing and tourism industries.

Preservation of Maritime Historic and Cultural Resources

In the case of designating a NOAA National Marine Sanctuary and often other types of MPAs, protection of historic maritime resources can be a major consideration. Although designation for the benefit of living resources and historic/cultural resources both hold the name “marine sanctuary”, resource management can look very different. Each sanctuary has a unique management plan — drafted by NOAA and the sanctuary’s advisory council — to define how management goals will be met. Sanctuaries that are designated to protect historic resources often have management plans highlighting tourism; education and recreation opportunities; archaeological research prioritization; and a preservation strategy. Examples of this type of designation within the United States include the [Monitor National Marine Sanctuary](#) and [Mallows Bay-Potomac River National Marine Sanctuary](#).

*Enhancing Fisheries, Restoring Ecosystems, and
Improving Biodiversity*

MPA designation for the purpose of preserving living resources and habitat have shown to be an effective management strategy that helps increase biomass and biodiversity within marine ecological communities. There is a weight of evidence that shows the significant benefits to ecosystems after some sort of protected area designation from biomass increases ([Sala & Giakoumi, 2017](#); [Caselle et al., 2015](#); [Solar et al., 2015](#)), greater biodiversity and habitat complexity ([Fidler et al., 2018](#); [Pichegru et al., 2010](#); [Stockwell et al., 2009](#); [Howarth et al., 2015](#)), and more productive fisheries surrounding the protected area ([Leisher et al., 2007](#); [Aburto-Oropeza et al., 2011](#); [Hunter et al., 2021](#); [Bucaram et al., 2018](#); [Abesamis & Russ, 2005](#)).

For example, the state of California has many MPAs along its coastline that have been studied in an effort to quantify the applicability of MPAs in fishery management within those ecosystems. A prime case study of MPAs positively affecting fisheries outside no-take areas is the network of MPAs around the Channel Islands. Within 5 years after designation, studies have shown increased size and abundance of spiny lobster as well as increased capacity for kelp forest habitats to thrive outside the MPAs ([Lenihan et al., 2021](#); [Caselle et al., 2015](#); [Lafferty, 2004](#)).

Bolstering Local Economic Opportunity

In addition to benefits to local fisheries, designation has also shown to benefit the tourism industry, providing opportunity to maritime business owners as well as other community members. ([Van Beukering et al., 2013](#); [Leisher et al., 2007](#); [Aburto-Oropeza et al., 2011](#); [Hunter et al., 2021](#); [Bucaram et al., 2018](#); [Abesamis & Russ, 2005](#)). Specifically, recreational scuba divers have an affinity for protected areas with 70% of the worldwide annual scuba dives occurring within MPAs of some designation. MPA designation serves as an economic opportunity where high or full protection could generate “\$2 billion per year in direct tourism revenue (not including economic multipliers)” for recreational dive sites currently under no protection ([Cabral et al., 2025](#)).

Some have found MPA ecotourism, when paired with traditional fishing and aquaculture, has yielded higher income for local community members ([Pham, 2020](#)). Others have found no net costs to fisheries after MPA designation, with one study highlighting 48 examples of fishery-related economic benefits in 25 countries, and 31 examples of tourism-related economic benefits in 24 countries ([Costello, 2024](#)). However, the tourism industry cannot always serve as a replacement for fishing and aquaculture. Educating the ecotourism workforce to improve success and an assessment of livelihood vulnerability should be a primary consideration when considering a no-take level designation to avoid unintended community impacts ([Pham, 2020](#)).

3.2 | *Marine Protected Area Case Studies*

3.2.1 | Channel Islands National Marine Sanctuary

The Channel Islands National Marine Sanctuary, designated in 1980, spans 1,470 square miles of ocean waters across the Northern Channel Islands, which sits right off the coast of Santa Barbara & Ventura Counties, California. The sanctuary was originally created with the purpose to protect the natural beauty and marine resources of the islands; however, it is also home to important cultural heritage that ties back to the indigenous Chumash culture ([Channel Islands National Marine Sanctuary, n.d.](#)).

The Channel Islands National Marine Sanctuary supports and protects an ecologically rich and biodiverse marine ecosystem ([Channel Islands National Marine Sanctuary, n.d.](#)). A study that investigated the effect of no-take regulations for two important Channel Island predators (California sheephead & California spiny lobster) shows how effective sanctuary designations are increasing the biomass, abundance, diversity, and size of these marine species ([Caselle et al., 2015](#)). The Channel Island National Marine Sanctuary not only supports the health of marine life, but also benefits coastal communities by maintaining marine populations for the continued use of commercial fishing, recreational

fishing, scuba diving, tourism, science, and cultural activities.

3.2.2 | Papahānaumokuākea Marine National Monument

The Papahānaumokuākea National Marine Sanctuary, located within the Pacific Ocean near Hawaii, was designated in January 2025 and overlaps with the marine portions of the Papahānaumokuākea Marine National Monument. Papahānaumokuākea spans 582,570 square miles, making it the largest sanctuary within the National Marine Sanctuary System. Papahānaumokuākea protects cultural, historical, and natural resources while also providing opportunities for advancing science, increasing environmental education and outreach, and engaging local communities ([Papahānaumokuākea National Marine Monument, n.d.](#)).

The Papahānaumokuākea National Marine Sanctuary and National Monument is also the world's largest no-fishing zone. This restriction on fishing has had enormous success in increasing the abundance of marine species within and outside of the sanctuary's borders. A study conducted in 2022 by the University of Hawaii highlighted the positive "spillover" effects (increased numbers and size of fish outside of the no-take zone's boundaries) Papahānaumokuākea has had on migratory species, specifically the yellowfin tuna and bigeye tuna populations. Catch data collected aboard fishing vessels have shown that since the designation of the Papahānaumokuākea Marine National Monument, the catch rate of yellowfin tuna in nearby waters increased by 54%

while bigeye catch rate increased by 12% ([Medoff et al., 2022](#)).

3.2.3 | Thunder Bay

Designated in 2000, the Thunder Bay National Marine Sanctuary became the nation's 13th national marine sanctuary ([National Oceanic and Atmospheric Administration, 2013](#)). The sanctuary provides protections to over 100 shipwrecks in Lake Huron off the Michigan coast, ([National Oceanic and Atmospheric Administration, n.d.-d](#)) and while originally designated as 448 square miles, it was recently expanded to 4,300 square miles driven by strong public support ([National Oceanic and Atmospheric Administration, 2014](#)). Although the sanctuary only manages the maritime archaeological resources, designation does benefit the ecosystems within the boundaries of the sanctuary. The wrecks themselves act as artificial reefs ([National Oceanic and Atmospheric Administration, n.d.-e](#)) that provide habitat to many aquatic species and the designation allows the deterrence of activities that would otherwise damage these habitats. Additionally, Thunder Bay National Marine Sanctuary hosts multidisciplinary research that provides a greater understanding of the area's archaeological significance, water quality, habitat quality, living resources in and around the sanctuary, and invasive species threatening the wrecks ("[Thunder Bay National Marine Sanctuary 2013 Condition Report](#)", n.d.; [National Oceanic and Atmospheric Administration, n.d.-b](#)).

Chapter 4: Marine Protected Areas within the Chesapeake Bay

MPAs within the Chesapeake Bay have been a topic of interest for many years. In August of 2004, the Chesapeake Bay Program's [Scientific and Technical Advisory Committee](#) (STAC) hosted a workshop focused on spatial management ([Scientific and Technical Advisory Committee, 2004](#)). This workshop gathered diverse stakeholders from across the region to identify opportunities for increased spatial management – including MPAs – and to identify and define potential issues and/or concerns. Although participants of the workshop were supportive of the idea of increasing spatial management in the Chesapeake Bay, the results of the workshop highlighted several gaps that need to be addressed before moving forward, which include: (1) a need for increasing stakeholder engagement, (2) creating an inventory of present spatial management efforts, (3) advancing science to support the need for spatial management over conventional management approaches, (4) monitoring spatially managed areas & the benefits/costs of implementation, and (5) understanding concerns of public access & permanency of protected areas ([Scientific and Technical Advisory Committee, 2004](#)). Since this workshop, many of these issues have been addressed; however, information and action regarding MPAs in the Chesapeake Bay remains low.

While not an official MPA designation, a recent “Hope Spot” designation by [Mission Blue](#) has highlighted the Chesapeake Bay as part of an effort to create a global network of MPAs. Mission Blue is an international non-profit, founded by renowned oceanographer Dr. Sylvia Earle, whose mission is to bring global attention to the ecosystems most critical to the health of our oceans. They partner with local groups, known as “hope spot champions”, to strengthen existing protections and build momentum for new protections. In June 2025, Mission Blue designated the Chesapeake Bay as their newest Hope Spot, highlighting its importance for a diverse array of wildlife and people/cultures. This new designation may put the Chesapeake Bay in the spotlight as a potential region for additional marine protection or just serve as a catalyst for increased resources, partnership, and momentum of the Chesapeake Bay restoration movement ([Mission Blue, 2025](#)).

Note from the Authors:

The designation of the Chesapeake Bay as the newest Hope Spot has aligned with our effort to better understand spatial management efforts and MPAs within the Chesapeake Bay. Our interest in this topic stems from our personal & professional connections to the Bay, as we live and work within its watershed every day. Due to the cross-jurisdictional nature of Chesapeake Bay restoration, conservation, and management, the idea of MPAs and the implications of this management tool in such a culturally rich and highly congested area is intriguing. The remainder of this report will focus on better understanding the current state and management of marine living resources in the Chesapeake Bay within the lens of spatial management.

4.1 | Management & Current State of the Chesapeake Bay's Most Iconic Marine Living Resources

The Chesapeake Bay is home to a vast array of aquatic and marine species, some of which are key components to the nation's fisheries. It is important to understand the current state of the living resources within the Chesapeake Bay to ensure adequate management action for healthy and sustainable populations.

The management of marine resources in the Chesapeake Bay is a multi-jurisdictional effort led by Maryland Department of Natural Resources (MD DNR), Virginia Marine Resource Commission (VMRC), and the Potomac River Fisheries Commission (PRFC), with guidance from NOAA and the Atlantic States Marine Fisheries Commission (ASMFC). All jurisdictions use an ecosystem-based fisheries management approach that depends upon the best available science for decision making. Survey studies that estimate the current population of a species help inform the targets and baselines from which fisheries are managed. Management actions – such as setting catch limits, restricting the use of certain fishing gear types, establishing state-defined

sanctuaries, or closing/opening a fishery – help ensure the continuation of sustainable commercial and recreational fishing practices.

American Shad

American Shad was one of the largest and most valuable fisheries within the Chesapeake Bay region. The springtime “shad run” migration from the open ocean into the watershed’s rivers and streams brought massive schools of adult shad to spawn. However, throughout the past 60 years, dam construction, pollution, and overfishing in the Chesapeake Bay has brought this species’ population to historic lows with (as of 2021) only two rivers’ populations being considered stable ([Chesapeake Bay Foundation, 2022](#)).

The populations’ historic decline has led Maryland to close its commercial shad fishery in 1980 and Virginia’s to close in 1990 ([Chesapeake Bay Foundation, n.d.-a](#)). Limited harvest was re-opened in 2003 in the Potomac River fishery, but according to a 2020 stock assessment, most of Maryland’s shad populations in other tributaries are unknown or considered depleted ([Chesapeake Bay Foundation, n.d.-a](#)) ([Chesapeake Bay Program, n.d.-c](#)). Jurisdictions, like Maryland, are currently focused on improving American shad populations by removing dams, restoring habitat, and raising shad in hatcheries and then adding them to rivers ([Maryland Department of Natural Resources, n.d.-c](#)).

Striped Bass

Striped bass, also known as rockfish, are a revered species not only for their contribution to local economies, but also their critical role as a top predator in the Chesapeake Bay’s ecosystem. As their name suggests, they tend to be found around rocky areas or oyster reefs, feeding on smaller fish and other animals. Rockfish spend the first 3-8 years of their life in the bay before annually migrating up and down the eastern Atlantic coast for their adult life where they can live as long as 30 years and grow to 5 feet in length ([Chesapeake Bay Foundation, 2022](#)).

After bouncing back from a large decline in their population in the 1970s and 80s, rockfish are again

experiencing record low numbers ([Chesapeake Bay Program, n.d.-d](#)). While populations are indeed struggling to increase, overfishing of striped bass is not cited as a main cause of their decline. Rather the lack of their main food source (menhaden – a small prey fish), low dissolved oxygen levels within the Bay, and effects of heat stress on spawning and juvenile growth ([Chesapeake Bay Foundation, n.d.-d](#)).

Since striped bass are a migratory species, the management of this fishery within the Chesapeake Bay is guided by the ASMFC. The commercial striped bass fishery is managed primarily by setting size limits, requiring permits, imposing regulations on certain gear types, and fishery closures during spawning season ([Maryland Department of Natural Resources, n.d.-a](#)).

Menhaden

Menhaden, a forage fish that feeds on very small animals and plankton, are the backbone of the food chain within the Chesapeake Bay. Their role of bridging the bottom to the top of the food chain serves as an ecological keystone for top predators such as striped bass (rockfish), osprey, and bald eagles. They also attract marine mammals such as dolphins and whales in search of food into the waters of the Chesapeake. The Bay is an important nursery for Menhaden, who begin their life hatching in open ocean and drifting with currents into the Bay. However, the number of juvenile fish in the Chesapeake Bay dropped dramatically in the early 1990s due to large-scale over-harvest and has remained well below the long-term average ([Chesapeake Bay Foundation, n.d.-b](#)).

Large operations continue to threaten the population of menhaden, so much so that in 2012 the ASMFC’s Benchmark Stock Assessment showed the total menhaden population was at its lowest level on record. As such, a fisheries management plan was drafted, including [ecological reference points](#) (ERPs) which not only account for the human demand on menhaden, but also the predatory species which rely on menhaden as well. In 2023, the state of Virginia directed the Virginia Institute for Marine Science (VIMS) to develop [a scientific plan](#) to understand the

menhaden population's role in the overall Chesapeake Bay ecosystem and their effect on the abundance of predatory species. The plan was developed and supported by many stakeholders, including Omega Protein Corporation – a Canadian owned company that harvests three quarters of all Menhaden along the United State's East Coast (and who fish near the mouth of the Chesapeake Bay) – for products such as fish food for large-scale salmon farming, nutritional supplements, and makeup ([Chesapeake Bay Foundation, n.d.-b](#)). However, the scientific plan remains unfunded despite concerns from watermen observing less menhaden and suspicion that the osprey nesting failure could be due to a lack of food coming from the menhaden population ([Chesapeake Bay Foundation, n.d.-b](#)).

Chesapeake Bay Foundation:

“ The 2025 Virginia legislative session saw three separate efforts to fund the sorely needed VIMS Menhaden Study Plan fail, due to Omega Protein's active opposition. Despite the fact that representatives from Omega Protein took part in designing the menhaden study plan along with scientists and a range of additional stakeholders, the company continues to thwart efforts to complete the study and address the mounting uncertainties about the health of the Chesapeake Bay's menhaden and the predator species dependent on them. ”

(Chesapeake Bay Foundation, n.d.-b)

Due to menhaden's migratory nature, the ASMFC sets the total allowable catch (quota) of menhaden within each jurisdiction. However, there are no size limitations and the fishery is open year-round, until the state-wide quota is met. After quotas are met, depending on the jurisdiction, the fishery either closes or switches to a permitted fishery. There are also varying regulations on gear types, particularly around pound nets and purse seines. ([NOAA Fisheries, n.d.](#)), ([Virginia Register of Regulations, 2023](#)) ([Maryland Department of Natural Resources, 2017](#)).

Oysters

The Chesapeake Bay's oyster population is at 1% of its historic density in areas of Chesapeake Bay due to overharvesting, disease, and other factors ([Anchondo et al., 2024](#)). However, successful large-scale restoration and conservation management actions have been taken by Chesapeake Bay states, which include prohibiting the harvest of oysters in some of the Bay's tributaries. Despite controversy among stakeholders and the prevalence of two of the most common oyster parasites, these areas have been found to contain abundant populations of oysters and other animal life ([Anchondo et al., 2024](#)).

In 2021 and 2022, both Maryland and Virginia reported the highest numbers of juvenile oysters in the past 30 years and mortality from disease has fallen consistently below average in the past few years ([Chesapeake Bay Foundation, 2022](#)). These are strong signs of recovering populations, however an increased number of oysters has been met with increased harvests ([Chesapeake Bay Foundation, 2022](#)).

In addition to being desirable for seafood markets, oysters provide important habitat for many species within the Chesapeake Bay. Naturally occurring oyster reefs form 3-dimensional structures that provide shelter to hundreds of animals. However, oyster dredging (one form of oyster harvest) negatively impacts oyster reefs by destroying their 3-dimensionality and reducing them to flat layers of dead shell and live oysters spread thinly over the Bay's bottom ([Chesapeake Bay Program, n.d.-b](#)).

Oyster harvest within the Chesapeake Bay is managed by MD DNR, VMRC, and PRFC. Regulations vary by jurisdiction; however, all jurisdictions require oyster fishery permits for harvesters, limitations on gear types (such as dredging gear), and restrict harvest during the warmer months (March/May to October). Maryland has recently announced their decision to maintain their current regulations for the upcoming 2025-2026 which includes daily bushel limits, regulations on the number of harvest days per week, and limited harvest closures in certain tributaries ([Maryland Department of Natural Resources, Fishing and Boating Services, 2025](#)).

Blue Crab

The Blue Crab is the most iconic species of the Chesapeake Bay and is one of the most valuable fisheries for both Virginia and Maryland. Annually, MD DNR and VIMS perform a winter dredge survey to estimate the amount of blue crabs in the Bay. In 1990, it was estimated that there were almost a billion crabs in the Bay. In 2025, the Chesapeake Bay saw the second lowest abundance on record with an estimated 238 million crabs in the bay. ([Maryland Department of Natural Resources, 2025](#)). Yet, despite the relatively low number of crabs, the fishery is considered sustainable as the amount of reproducing female crabs remains above levels set by fishery managers ([Chesapeake Bay Foundation, 2022](#)).

The blue crab fishery is managed by the three Chesapeake Bay jurisdictions with scientific guidance by the Chesapeake Stock Assessment Committee and NOAA. The Chesapeake Bay Blue Crab Stock Assessment provides a comprehensive understanding of the blue crab population, beyond that of the Winter Dredge Survey. This assessment compiles the most recent data into models that help determine the state of the blue crab population in the Chesapeake Bay and develop the reference point and threshold to which the blue crabs are managed ([Chesapeake Bay Program, n.d.-a](#)). The Winter Dredge Survey complements this assessment to determine if the population remains within the threshold of the current stock assessment ([Garvey, 2025](#)). The last stock assessment occurred back in 2011; however, a more recent stock assessment is currently being conducted for 2026 ([Zimmerman, 2024](#)). Blue crab fishery regulations that help maintain a sustainable blue crab population include: requirement of permits, size & catch limits, gear restrictions, and seasonal closures.

4.2 Current Marine Protected Areas within the Chesapeake Bay Watershed

Note from the Authors:

To understand what MPAs are in the Chesapeake Bay we leveraged [NOAA's Marine Protected Area Inventory](#) — a database of all state and federally designated MPAs. This does not include conservation easements (a voluntary, legal agreement that permanently limits uses of the land in order to protect its conservation values ([What Is a Conservation Easement?, n.d.](#)), nor other protected lands that do not fall under NOAA's definition of an MPA. The data in the figure below was further filtered to look at the prevalence of the four types of MPAs described in Section 3.1.2. Lastly, Maryland's oyster sanctuaries were included to highlight the large-scale restoration and conservation efforts of the Chesapeake Oyster.

4.2.1 | Mallows Bay-Potomac River National Marine Sanctuary

Mallows Bay-Potomac River is the nation's 14th national marine sanctuary. It was designated in 2019 by NOAA after the state of Maryland and 60 supporting organizations submitted a nomination to consider the site for sanctuary status ([Maryland Department of Natural Resource, n.d.-b](#)). It is managed jointly by NOAA, the State of Maryland, and Charles County to protect the remnants of over 100 World War I-era wooden steamships—known as the “Ghost Fleet” ([National Oceanic and Atmospheric Administration, n.d.-c](#)).

Mallows Bay-Potomac River National Marine Sanctuary's [management plan](#) was co-developed by the State of Maryland and Charles County Government to set priorities to guide sanctuary programs and operations to conserve and promote its maritime historic and cultural resources. It includes a plan consisting of five actions with specifications for resource protection; recreation and tourism; education; research, science and technology; and sanctuary operations and administration.

*Enforcement in Mallows Bay-Potomac River
National Marine Sanctuary*

In the National Marine Sanctuary System, NOAA provides law enforcement presence to deter and detect violations of sanctuary regulations. The National Marine Sanctuary program often utilizes cooperative partnerships with other agencies such as the U.S Coast Guard, the U.S. Department of the Interior, and local/state marine and wildlife enforcement agencies. In the case of the Mallows Bay-Potomac River Sanctuary, the area is co-managed by the State of Maryland and Charles County ([15 CFR Part 922 Subpart S -- Mallows Bay—Potomac River National Marine Sanctuary, n.d.](#)). Throughout the National Marine Sanctuary System, enforcement personnel use vessels and aircraft to monitor the area for violations, while the sanctuary system seeks to deter potential violations through a “philosophy that fosters voluntary compliance through educating sanctuary users and promoting a sense of stewardship toward the living and cultural resources of the sanctuary” ([National Oceanic and Atmospheric Administration, n.d.-a](#)).

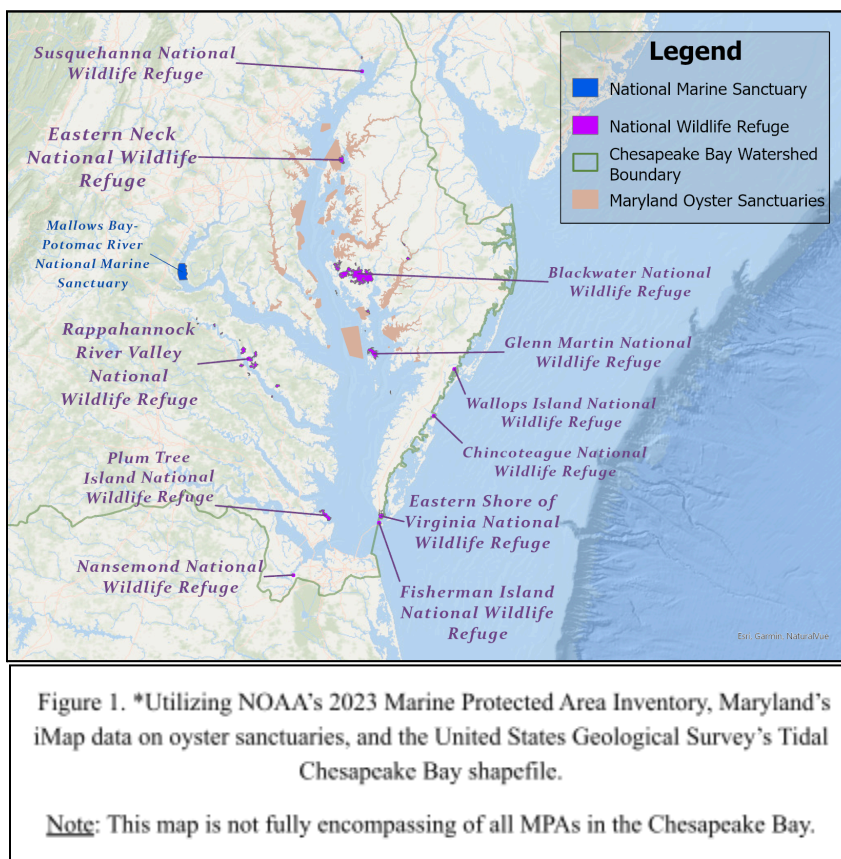
4.2.2 | Chesapeake Bay Oyster Restoration Areas

In an attempt to increase the oyster population in the Chesapeake Bay, restoration efforts have focused on rebuilding oyster reefs, and in Maryland, creating state-designated “oyster sanctuaries” that restrict harvest of oysters indefinitely. Maryland oyster sanctuaries are managed by MD DNR, with strong collaboration from US Army Corp of Engineers (USACE), NOAA, and local organizations like the Oyster Recovery Partnership.

Unlike Maryland, Virginia does not establish “oyster sanctuaries” (which are permanently closed) but instead restricts harvest on restored reefs temporarily. Virginia oyster reefs are managed by Virginia Marine

Resource Commission, with strong collaboration from USACE, NOAA, and local organizations like Oyster Recovery Partnership, The Nature Conservancy, and Chesapeake Bay Foundation ([Chesapeake Bay Foundation, n.d.-c](#)).

The goal of establishing oyster sanctuaries/restoration



areas is to help protect reproductive-aged oysters, increase disease tolerance (through natural selection), enhance natural reproduction, and maintain ecological services (like the provision of habitat & water filtration). Strong oyster sanctuaries (low mortality, high recruitment, etc.) do not need further investment of resources outside of their no-take designation. However, weak or degraded oyster reefs need additional support in the form of supplemented oyster substrate and juvenile oysters to help increase oyster biomass ([Maryland Department of Natural Resources, 2019](#)).

Enforcement in Maryland

In Maryland's oyster sanctuaries, enforcement of non-harvest areas is conducted by MD DNR's Natural Resources Police ([Army Corps of Engineers, Baltimore District, n.d.](#)). Maryland takes violations very seriously: where it used to take 3 violations for a waterman to lose their license, it can now take as little as one ([Kobell, 2020](#)). This shift comes from an estimate that 33 percent of oysters placed in Maryland sanctuaries between 2008 and 2010 have been removed by illegal harvests ([U.S. Army Corps of Engineers, Baltimore & Norfolk Districts, 2012](#)). GPS technology has been used on watermen's boats and has improved the enforcement of harvest restrictions in Maryland ([U.S. Army Corps of Engineers, Baltimore & Norfolk Districts, 2012](#)).

Enforcement in Virginia

VMRC is responsible for the enforcement of fishing regulations through reckoning licenses, confiscating harvesting gear, and hiring enforcement officers. In partnership with the VIMS Molluscan Ecology Program, the status of oyster populations at restoration sites is monitored. The Virginia Department of Environmental Quality (VADEQ) also contributes to preserving, protecting, and restoring the state's natural resources through law enforcement, monitoring, education, and management ([U.S. Army Corps of Engineers, Baltimore & Norfolk Districts, 2012](#)).

4.2.3 | National Wildlife Refuges in the Chesapeake Bay

There are several wildlife refuges in the Chesapeake Bay Watershed, each with their own management plan and area of focus. The Blackwater Wildlife Refuge, located in Cambridge, MD, was established in 1933 with a primary focus on the habitat and preservation of migratory birds. Now, not only is the refuge frequented by migratory and wintering birds, it is also home to one of the largest populations of both fox squirrels in the Delmarva peninsula, as well as breeding bald eagles along the East Coast ([U.S. Fish & Wildlife Service, n.d.-c](#)). The focus of the refuge still remains as habitat preservation, but has grown over time to accommodate different important species in the area.

The Eastern Neck Wildlife Refuge, located in Rock Hall, MD, was established in 1962 with a focus on migratory birds, similar to the Blackwater Wildlife Refuge. Today, it remains a crucial spot for wintering birds and waterfowl, especially the tundra swan which feeds off of the grasses along the rivers in the refuge ([U.S. Fish & Wildlife Service, n.d.-d](#)).

Enforcement of Regulations within National Wildlife Refuges

Enforcement of the management policies within the National Wildlife Refuge System is run by federal wildlife officers, law enforcement professionals in the natural resource and habitat management field. The primary work is investigating and managing crime happening on the refuge, along with crimes that impact the species living within the refuge ([U.S. Fish & Wildlife Service, n.d.-e](#)). Because different refuges may have different management restrictions, the enforcement policies may differ between refuges, though the work of federal wildlife officers exists across the FWS's National Wildlife Refuge System.

4.3 | MPA Impacts on Communities

While MPAs can be beneficial to a local ecosystem or a culturally important landmark, they can also impact the livelihoods of those who live in the surrounding communities. Nearby fishing communities are one of the most impacted by an MPA that places restrictions on fishing activity, as this can take away their primary means of work. One study analyzed fishermen's perception on the California MPA network, asking questions ranging from impacts on community livelihood and ecological outcomes to management and enforcement. Results showed that fishermen held generally negative views about MPA regulations because of the impacts on their economic and social wellbeing as a result of heightened restrictions on fishing ([Cook, 2024](#)).

Similar hesitations and opposition has been voiced within the Chesapeake Bay region. Following the Mallows Bay sanctuary designation, locals raised concerns about giving the federal government the ability to make and change regulations when they want to; additionally, the use of vague terminology like "large anchors" worried local fishermen that regulators wanted to leave regulations as broad as

possible for tighter restriction on fishing activity ([Office of National Marine Sanctuaries, 2019](#)). No matter how well-intended a designation project might be, the public's general distrust of regulators is a big factor in a community's opinions on proposed regulations – especially when it could impact their way of life.

To address mistrust and hesitancy of governmental involvement, MPA designators need to consider the direct impacts that MPAs and fishing restrictions have on local businesses and their communities. Centering their voices in these conversations is a crucial step to create equitable representation. This can be done by ensuring that each group of stakeholders is seen as an equal and unique group. A stakeholder group of watermen may have different priorities than a group of maritime business owners and acknowledging each group's interests individually gives them more ownership and affinity to the project. Combining them into one broader 'local businesses stakeholder' would diminish their individual influence and could weaken their trust in the project ([Gurney, 2015](#)). By making sure that all groups are included in every step of the process as equal stakeholders and ensuring clear, transparent, and informative communication about the proposed MPA, efforts can be made to minimize opposition towards MPA designation and subsequent harm from fishing restrictions.

Similarly, the oyster sanctuaries in Maryland saw hesitancies and opposition from local watermen. An oyster restoration project that began in 2010 was met with lots of pushback, with watermen voices convincing Governor Hogan to pause the Harris Creek project for a year ([Wheeler, 2025](#)). Concerns regarding oyster restoration projects in both Maryland and Virginia echo those regarding the Mallows Bay MPA restrictions, and further emphasize the importance of meeting watermen and coastal communities where they are and including them in every step of the designation process.

4.4 | Potential Areas of Interest and Their Stakeholders

Note from the Authors:

After learning more about the current MPAs within the Chesapeake Bay, we wanted to investigate habitats within and nearby the Chesapeake Bay. Looking at three unique habitats — Chesapeake Bay barrier islands, open ocean seamounts, and deep sea canyons. The rationale for choosing the three site types was due to the current work already being done to protect them and their unique ecological footprint. Open ocean seamounts and deep sea canyons were chosen due to the unique biodiversity found within nearby Northeast Canyons and the Seamounts Marine National Monument. We investigate further the Chesapeake Bay's barrier islands because this habitat type was highlighted during the author's informational interviews - emphasized for their role in preserving underwater grass meadow habitat. In the following sections we seek to not only understand these areas' value, but show the many potential stakeholders who would need to be engaged if MPA designation was pursued.

4.4.1 | Chesapeake Bay's Barrier Islands

Barrier islands are highly valued across the United States for coastal real estate development opportunities. Currently, ocean facing barrier islands (those exposed to high-energy ocean waves) are heavily developed and likewise, demand is growing for more sheltered, lower wave energy waterfront environments, such as those in the Chesapeake Bay ([Cooper, 2007](#)).

Barrier islands in sheltered, low-energy environments rely on vegetation to stabilize their morphology. Marshes, underwater grasses and other vegetation can grow around low-energy barrier islands, stabilizing the island as well as reducing the impact of storm waves, improving water clarity and reducing excess nutrients ([Cooper, 2007](#); [Chesapeake Bay Program, n.d.-e](#)). Within the Chesapeake Bay, this vegetation also provides shelter and food to many key species such as microscopic zooplankton, crabs, and small fish which in turn supply food for other predatory species of fish and waterfowl ([Chesapeake Bay](#)

[Program, n.d.-e](#)). If these areas are developed, the health of nearby underwater grass habitat will likely decline, negatively influencing the living resources living within ([Li et al., 2007](#)).

The Chesapeake Bay barrier islands are also home to unique histories and rich traditions practiced by those living and working on the water. These islands are considered “capsules of remarkably authentic Chesapeake history, environment, food and culture” ([Livie, 2014](#)) with some islands featuring local specialities such as Smith Island Cakes, a treat that has been iconic for generations ([Landon & Landon, n.d.](#)). Some islands – being so secluded from the mainland – have even developed unique dialects not found on the mainland ([Thornton, 2024](#)). The islands have a long history of people living and working on the water, with some of Maryland’s oldest human artifacts found on these barrier islands ([Blankenship, 2007](#)).

These islands are valued by many, but they are disappearing due to shoreline erosion and sea level rise ([Stories of the Chesapeake Heritage Area, n.d.](#)). Over 400 of the originally mapped islands cannot be found on modern navigational maps ([Maryland Sea Grant, n.d.](#)). The protection of these islands is important to a wide array of stakeholders, including those who value the islands’ treasure trove of stories & unique cultural heritage, real estate development opportunities, and provision of habitat for living resources. If MPA designation is pursued to preserve these unique areas, managers will need to consider the interests of all the different stakeholders’ interests.

4.4.2 | Open Ocean Seamount Habitats

Seamounts are underwater mountains that do not break the water’s surface. Mapping data obtained from survey ships show that there are more than 100,000 seamounts at least 1,000 meters high. However, less than 0.1% of seamounts in the ocean have been explored. Studies indicate that seamounts function as an “oasis of life”, with higher species diversity and biomass found within this habitat, compared to the waters around it and on the flat seafloor ([NOAA Ocean Exploration, 2021](#)). Seamounts provide species with shelter from predators, increased access to food, and spawning

and nursery habitat. Seamounts are also productive fishing grounds for more than 80 commercial species worldwide ([Cirilla et al., 2021](#)).

While there are no seamounts within the Chesapeake Bay itself, there are several seamounts off the east coast of the United States. The closest to the Bay is the Caryn Seamount, but there are many other seamounts that form the New England Seamount Chain and make up the Northeast Canyons and Seamounts Marine National Monument ([NOAA Fisheries, 2024](#)). While MPA designation of seamounts has become a topic of interest, the challenge is to balance the interests of the stakeholders using these areas. Fishermen, researchers, maritime business owners and wildlife conservationists, as well as those who seek to extract non-living marine resources such as natural gas and oil, are some of the stakeholders of these areas.

The Davidson Seamount in the Monterey Bay National Marine Sanctuary is described as one of best explored and most protected seamounts in the world ([Monterey Bay National Marine Sanctuary, n.d.](#)). The Monterey Bay National Marine Sanctuary doesn’t actually restrict fishing above the Davidson Seamount (above 3000 feet deep). Instead, this model focuses conservation on the deep sea habitat rather than on the entire area’s water column. This management method could be considered in the Mid-Atlantic to pursue conservation goals while balancing the interests of other stakeholders who use these areas.

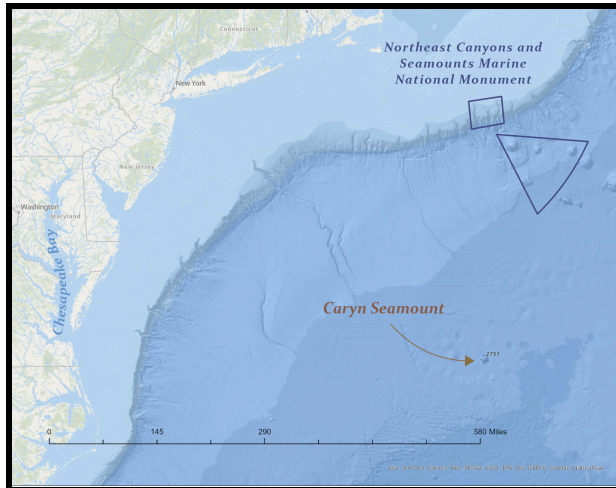


Figure 2. Locations of the Northeast Canyon and Seamounts Marine National Monument and Caryn Seamount

4.4.3 | Deep Sea Canyon Habitats

Similar to ocean seamounts, deep-sea canyons are considered to be biodiversity hotspots. Interestingly, diversity of life within these habitats tends to increase with increasing depth which isn't usually the case for deep sea landscapes (Nizinski, n.d.).

Due to the unique conditions that the steep slopes of the canyons provide, a hard surface is exposed. This allows deep-sea coral larvae and other animals the opportunity to anchor and establish where they otherwise couldn't. Usually the soft sediment covering the seafloor isn't conducive to these animals because of unstable substrate and the risk of being buried in. The unique flow of currents through the canyon also provides a steady influx of nutrients (food) allowing these ecosystems to thrive (France & Kenchington, 2019).

An example not too far from the Bay – off the coast of New England – is Northeast Canyons and Seamounts Marine National Monument. The National Monument was designated under joint management from NOAA Fisheries and

USFWS for the purpose of restricting potentially harmful activities within the boundaries of the national monument and establishing a management plan to maintain these unique ecosystems (NOAA Fisheries, 2024). The designation of this site protects submarine canyon habitat as well as seamount habitat.

Similar to ocean seamounts, the designation of deep sea canyons is a balancing act between the interests of the angling community, maritime business owners, conservationists, oil drilling corporations and others. In 2016, the National Aquarium submitted a proposal to nominate the Baltimore Canyon (a deep-sea canyon 60 miles from the Ocean City, MD inlet) as the next national marine sanctuary (National Aquarium, 2016). However, the nomination was withdrawn in 2017 after heavy opposition from anglers and maritime business owners (Tabeling, 2016). Within their withdrawal letter, the National Aquarium stated their intention to continue to collect community input on the potential designation (National Aquarium, n.d.).

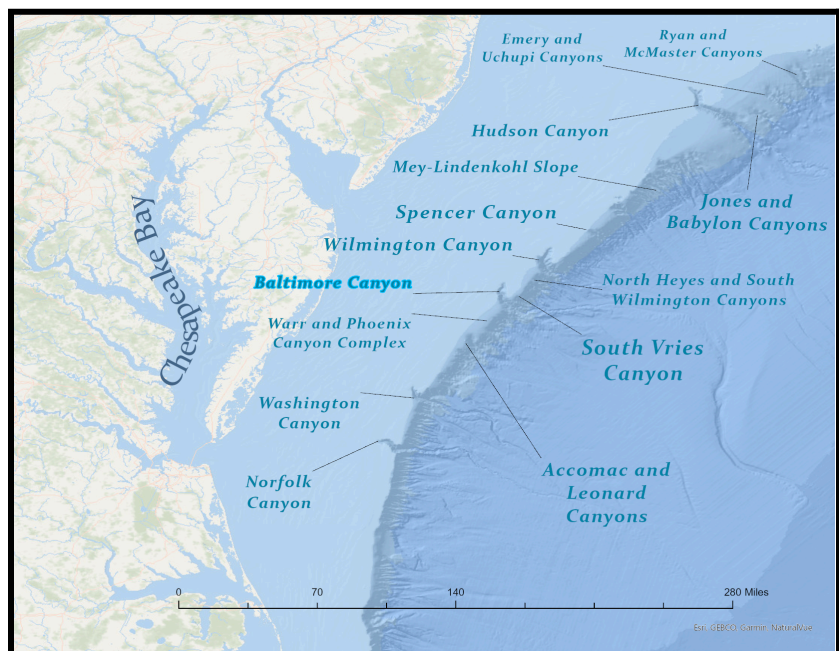


Figure 3. Location of the Baltimore Canyon

Chapter 5: Discussion

As shown within this report, the role of MPAs within the Chesapeake Bay is a complex and sensitive topic. Spatially managing resources in such a populous watershed requires the inclusion and involvement of many different stakeholders such as commercial fishing communities, indigenous communities, state managers, recreational anglers, academic researchers, and the tourism industry. It is important to understand and honor the cultural ties that people have with the Bay and how regulations may impact people's connection to this environment. In addition, MPAs must consider the ecological and economic impacts while also adapting to environmental change over time. The resources and people of the Chesapeake Bay are interwoven and connected beyond state lines, which introduces another obstacle of multi-jurisdictional management with varying levels of state and federal regulations and types of protected area designations.

The designation of the Chesapeake Bay as the newest Hope Spot has the potential to bring greater attention to the protection of resources within this region. While MPAs can provide enormous benefits to the local ecosystem, managers must be considerate to the impacts MPAs may have on the well-being of those that depend upon the living resources of the Bay. Due to the complexity surrounding the management of the Chesapeake Bay, it seems as though the designation of sanctuaries for historical and/or cultural resource preservation has been the most approachable method for any kind of spatial management. This type of protected area designation has the most limited restrictions on fishing; however, small ripple effects can still create benefits to the natural ecosystem and living resources within the sanctuary. By establishing importance to an area through this type of designation, more funding can be directed towards environmental education programs, research, and stewardship.

Looking forward, the topic of spatial management in the Chesapeake Bay is one that remains filled with questions and opportunities. As of today, online databases such as NOAA's "Marine Protected Area Inventory" are tools to understand the current spatial distribution of protected areas in the Bay as well as their associated fishing restrictions (see Figure 4).

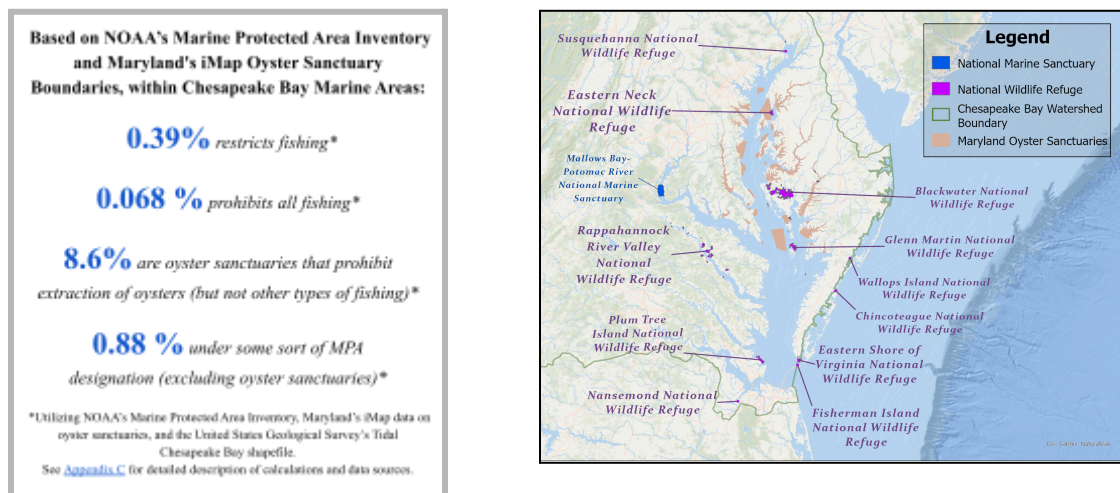


Figure 4. (Left) Percentage of fishing/harvest restrictions across all MPA's and oyster sanctuaries in the Chesapeake Bay. (Right) Locations of National Marine Sanctuaries, National Wildlife Refuges, and MD Oyster Sanctuaries. Information Retrieved from NOAA's 2023 Marine Protected Area Inventory and Maryland's iMap Oyster Sanctuary Boundaries

However, this approach is limited because it does not include all known USFWS wildlife refuges and other spatial management actions such as SAV protection zones, Virginia's summer blue crab spawning sanctuary, and other state specific spatial regulations.

Future work could investigate the adoption of a "Chesapeake Conservation Area Network" which would identify, map, and collect key attributes of all oyster sanctuaries, non-harvest areas, national marine sanctuaries, national estuarine research reserves, national wildlife refuges, national monuments, and protected heritage sites within the Chesapeake Bay. This effort could help identify the spatial connectivity among these sites, their ecological health, and the types of habitat they encompass which could lead to the prioritization of "key" protected areas (sites that, if lost, would disproportionately impact the network's function).

Additionally, future research could investigate the socio-ecological impact of protected area designations on Chesapeake Bay landscapes, habitats, and communities. How can the cultural and ecological integrity of these places be preserved while also benefitting communities and adapting to changing conditions? Questions such as these are important as we continue to restore the Chesapeake Bay, its tributaries, and the land that surrounds it for generations to come.

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Appendix

Appendix A: Informational Interviews

Individual 1

This individual spoke to enforcement of the oyster sanctuaries within Maryland. They mention that some funding comes from NOAA and they effectively “contract” to Maryland Natural Resources Police for enforcement.

Individual 2

The interview with this individual gave a lot of insight to the history surrounding the oyster fishery, the sanctuary designations, and some of the perspectives/concerns raised by watermen. It was mentioned that aquaculture-based systems have been of interest to fishery managers and the oyster industry for many years now, but shifting the wild harvest oysterman to to aquaculture oyster farming is not easy or practical due to the considerable financial investment needed to start an aquaculture operation and the knowledge-gap between harvesting wild oysters and overseeing an aquaculture facility.

There was consideration to use non-native oysters in aquaculture systems because the native oyster, *Crassostrea Virginica*, has been plagued by parasites that cause diseases Dermo (caused *Perkinsus marinus*) and MSX (caused by *Haplosporidium nelsoni*) ([Malmquist, 2021](#)). These diseases cause very high mortality rates for oysters older than 2 years old. In the late 1990 and early 2000’s oyster, *Crassostrea Ariakensis*, was proposed to replace the native oyster fisheries. Initially Virginia and Maryland proposed to introduce the Asian oyster to replace the native oyster, then later to have triploid Asian oyster in aquaculture. The proposal included use of triploidy oysters rather than diploidy where the added chromosome greatly reduces the potential for reproduction. However since the reproduction rate was non-zero and the consequence to the ecosystem was poorly understood the initiative was ultimately abandoned.

To restore the Chesapeake oyster fishery, Maryland and Virginia have implemented an oyster sanctuary

program, with resource assistance from NOAA, where large scale oyster reef restoration would occur and oyster harvest would be prohibited within certain tributaries in the Bay. This was a very controversial decision where consensus was attempted but not reached. Watermen weren’t necessarily opposed to the idea of sanctuaries as long as they weren’t in the area they harvested. They also asked why wouldn’t the sanctuaries have rotating harvest/non-harvest timeframes since disease would kill most of the sanctuaries’ adult oysters anyways. Lastly, crab harvesters didn’t like the idea of the sanctuaries being 3 dimensional reefs because the current flat oyster beds allow crab pots to be dropped without concern of losing gear in the structure of the oysters.

Ultimately the decision for oyster sanctuaries to be non-harvest was largely influenced by limitations of federal funding to be used for commercial harvest. Therefore the states decided to create no-harvest oyster sanctuaries but permitted fishing and crabbing within the designated areas. The idea is that if you increase the amount of reproducing oysters, the “spill over” effect will allow the population to start to recover. Also while disease will continue to affect the population of sanctuary oysters, the new generations would have higher genetic disease resistance.

The decision to limit harvest in sanctuaries remains controversial, and discussions on how to support the oyster fisheries and the ecosystem services of oyster reefs continue to this day.

Individual 3

The National Aquarium (NA) spearheaded the nomination of the Baltimore Canyon National Marine Sanctuary in 2016. The project was initiated after a policy change allowed non-governmental groups to submit sanctuary proposals. The goal was to establish a protected marine area in the Baltimore Canyon, driven by NA’s mission to protect marine species and habitats. This “bottom-up” approach gave NA and its partners a new opportunity to influence marine conservation policy. NA collaborated with

environmental groups and the Maryland Department of Natural Resources (DNR) to promote the designation and compile the application.

The main challenge encountered during the proposal process was a significant backlash from various stakeholders, primarily fishermen and government officials from Maryland's Eastern Shore. These groups voiced strong opposition during the public feedback period, fearing the sanctuary would have a negative economic impact by deterring fishermen and recreational boaters. A critical misstep was failure to properly engage with these stakeholders before submitting the proposal. This lack of communication, coupled with the threat of funding cuts from elected officials, ultimately led to the withdrawal of the sanctuary proposal.

When thinking about proposing a marine sanctuary now, the importance of early and open communication with all stakeholders is a major theme. Key takeaways for future projects include addressing big, difficult questions upfront, such as who will monitor and enforce regulations, and being mindful of the language used to describe the project. When considering other potential sanctuary projects, such as one in the Chesapeake Bay, this individual highly encouraged practitioners to consider climate change, cultural history, and private property rights when planning for protected areas.

Individual 4

There are 3 main ways for federal entities to create national protected areas, whether they are National Parks, a trail network, refuges, historic sites, etc. The first is by Presidential Authority through the Antiquities Act, which grants the President authority to designate specific protected areas on federal lands. The second is by a federal agency using granted authority to begin the research process. Not all federal agencies have the power to do this without congressional direction, however. The Bureau of Land Management and Fish and Wildlife Service are two agencies with some level of authority to do this. The third is by congressional direction to begin the research process for designation, which is followed through by the federal agency that is given the direction. The National Park Service requires this approval.

The Chesapeake region has had several attempts to create a Chesapeake Bay national area with some level of protection. One attempt led to the creation of Chesapeake Bay Gateways Program, established in 1998, as it was deemed a more feasible option to connect important landscapes through NPS resources. Another attempt led to the creation of two water trails (Captain John Smith Chesapeake National Historic Trail and Star Spangled Banner Trail) instead of a broader National Park designation. As of now, legislation for creating a Chesapeake National Recreation Area is awaiting congressional action after being reintroduced to the senate.

Individual 5

Mallows Bay MPA is co-managed by NOAA, the State of Virginia, and Charles County, VA. The purpose of this MPA is to protect historically significant resources in the area, specifically the Ghost Fleet remains from World War I. Collaboration between NOAA's Office of National Marine Sanctuaries and the National Marine Sanctuary Foundation has mutually benefited each agency's ability to manage the area and achieve desired outcomes within the sanctuary system.

While the main focus of the Malloys Bay MPA designation is to protect the historical heritage resource for the public, federal designation brought in funds to be able to benefit the ecosystem as well through SAV monitoring and educational outreach initiatives. There is a political benefit to designating a site from the historic preservation lens as opposed to an ecological conservation lens depending on federal priorities and available funding opportunities at the time. Additionally, historic preservation designations can be hard to oppose if they do not threaten the communities' fishing rights. This can make it easier to gain support from locals and congress.

Individual 6

This individual discussed how the designation of the oyster reef in the Chesapeake Bay was controversial, but also that a lot of watermen weren't necessarily opposed to oyster sanctuaries as an idea; they just didn't want it 'in their backyard'. They noted how

the idea of assisting watermen with transitioning towards aquaculture is not easy to implement. Culturally, watermen have been watermen for generations, and would be a barrier to switch industries altogether. They often do not have the necessary equipment or specific knowledge of aquaculture operations, and even if grants or technical assistance from local organizations were an option, that would require additional time and money just to apply.

Management of oyster reefs between Maryland and Virginia varies, and this has subsequent effects on how the community and watermen perceive the reefs. Maryland's reefs are open for fishing at any given

time until they become closed specifically for oyster restoration. This makes watermen frustrated as waters that they have fished on for years may suddenly become restricted. Virginia, however, has an opposite management style: their reefs are always closed for fishing to enhance oyster restoration, and can become open for fishing when the state deems the oyster population is at a good level. This method results in fewer watermen and fishing companies upset at the regulations because they were never used to fishing in the areas anyway, as they are normally closed. This highlights how different management strategies can have different impacts on the local communities.

Appendix B: Long Term Goal Questions Answered

What is the process of and entities involved in designation of an MPA?

The process and entities involved in designation of an MPA varies greatly by the type of MPA and the jurisdiction it falls under. In this report we cover the process and entities of National Marine Monuments (federal lead: NOAA), National Wildlife Reserves (federal lead: USFWS), National Parks (federal lead: NPS) and National Marine Sanctuaries (federal lead: NOAA). Each of these 4 federal designations have varying degrees of public engagement and partnership with state and local governments. See [Section 3.1.2](#) for more details.

Note that this report follows the 4 main federal designations and does not cover designations such as National Seashores, National Battlefields, National Preserves, National Recreation Areas, and others. Most of these are subtypes under NPS's National Park System. To see a list of the different sites falling under NPS's National Park System that do not fall under a national park visit [National Park System's "About Us" page](#). Additionally each state has their own protected area designation types and processes.

How to navigate the political, social, economic and other challenges associated with designation of protected areas?

Successfully navigating the political, social, economic and other challenges in designating a protected area seems to be a function of how well designators are listening to the stakeholders of the potential designation. Protected areas – both marine and terrestrial – often take a tremendous amount of partnership to reach goals defined when designating. Partnership requires trust and participation from multiple stakeholders which can only be cultivated when entities feel their interests, concerns and priorities have been heard and are prioritized. As such, a protected area that is built from the ground up (as opposed to presidential proclamation or federal agency directive) takes many years of conversations, negotiations, and relationship and trust building.

What are the laws and regulations regarding fishing at the different levels of MPA designation?

In the case of NOAA's National Marine Sanctuary System, each sanctuary has their own management plan which can be either fully restrictive or not restrictive at all depending on the stakeholder's desires and sanctuary goals. For more information regarding the National Marine Sanctuary Act's Fishing Regulations see [National Marine Sanctuaries Act Fishing Regulations Frequently Asked Questions \(FAQs\)](#).

Similarly, marine national parks, national wildlife refuges and national monuments don't necessarily restrict fishing and the management direction depends on the specific language accompanying each designation.

How can urban planning and public access be a major consideration in the protected area field and sustainable development as populations continue to grow?

Urban planning and public access are already major considerations when considering protecting an area from future development. When developing land, permittees must consider the effect of events such as agricultural or urban runoff will have on local water quality. If urbanization is not intentional there can be negative effects on the local environment – affecting drinking water, fishing safety and even the safety of recreation spaces. As such, the construction permitting process often requires environmental impact statements that attempt to ensure the safety of the project for current and future residents as well as health of the environmental system more broadly.

Marine protected areas also have the potential to provide protection to urban spaces against shoreline erosion. In the

case of islands whose shoreline is stabilized by vegetation or reef, the longevity of that urban space is increased as their susceptibility to wave energy is greatly reduced. However, protecting the vegetation or reefs could come with fishing or boating restrictions which may negatively affect community livelihoods. This is why it is so important to engage all stakeholders during the designation process to maintain trust and ensure benefit to the local communities.

Public access to protected areas creates an opportunity for people to connect with natural spaces. Many protected spaces create informational signage, trails, docks, and other means for the public to be educated about the environment they are immersed in as well as appreciate its recreational value. Many MPAs and other protected natural areas take advantage of educational opportunities to inspire stewardship and appreciation of the natural spaces and the creatures they support.

How does an MPA get designated with the nearby communities in mind? How do you ensure livelihoods are not harmed and ensure local voices are incorporated into the decision making process?

Out of the types of MPAs covered in this report, national marine sanctuaries, national parks and national wildlife refuges have codified responsibility to engage the public when designating an MPA. National marine monuments are the exception, where public engagement is not legally required, but often takes place. See [Section 3.1.2](#) for more details.

How does enforcement of MPAs work?

Enforcement of MPAs are often partnership based initiatives where state and federal agencies both contribute resources to enforce MPA regulations. For more information on Malloes Bay-Potomac River National Marine Sanctuary enforcement see [Section 4.3.1](#). For more information on the differences between Maryland and Virginia's enforcement of restoration areas see [Section 4.3.2](#).

Appendix C: Methodology for Executive Summary Percentages

Oyster Sanctuaries:

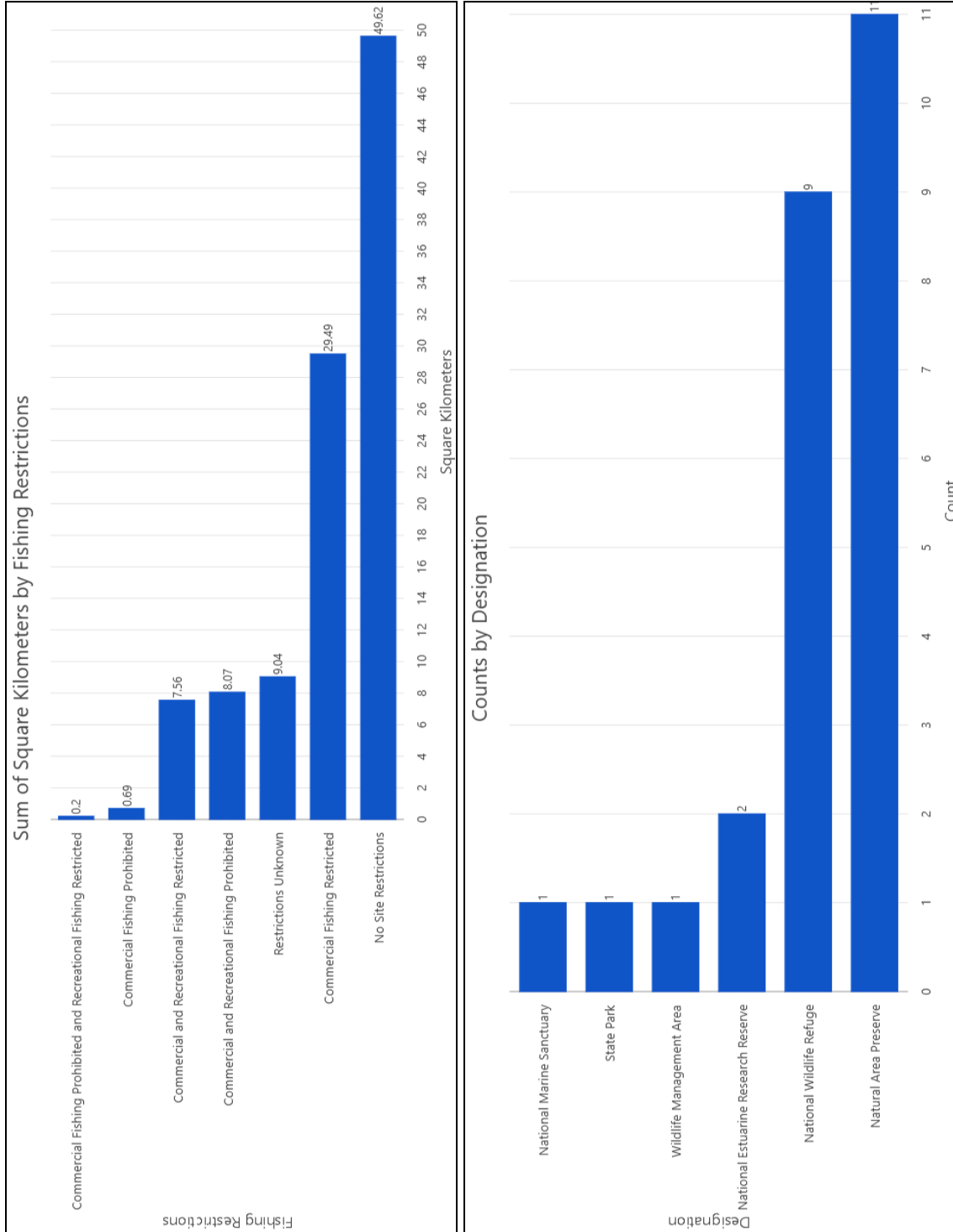
1. The extent of the [Chesapeake Bay's tidal region](#) was brought into the ArcGIS Pro environment and projected into the coordinate system "WGS 1984 Web Mercator (auxiliary sphere)" using the "Project" geoprocessing tool.
2. A new attribute was added to the [Chesapeake Bay's tidal region](#) called "CalculatedArea" set as the numeric data type "double" and the ArcGIS Pro "Calculate Geometry" function was used to calculate the area of the polygon in square kilometers. The total square kilometers from this calculation was 11,864.760989 km².
3. [Maryland State Oyster Sanctuaries](#) were brought into the ArcGIS Pro environment and projected into the coordinate system "WGS 1984 Web Mercator (auxiliary sphere)" using the "Project" geoprocessing tool.
4. A new attribute was added to the [Maryland State Oyster Sanctuaries](#) called "CalcArea" set as the numeric data type "double" and the ArcGIS Pro "Calculate Geometry" function was used to calculate the area of the polygons in square kilometers. These polygon areas were summed to get a total of 1,024.730803627893 km².
5. Therefore the amount of marine area prohibiting oyster harvest is $1,024.73 / 11,864.76 = 8.6\%$

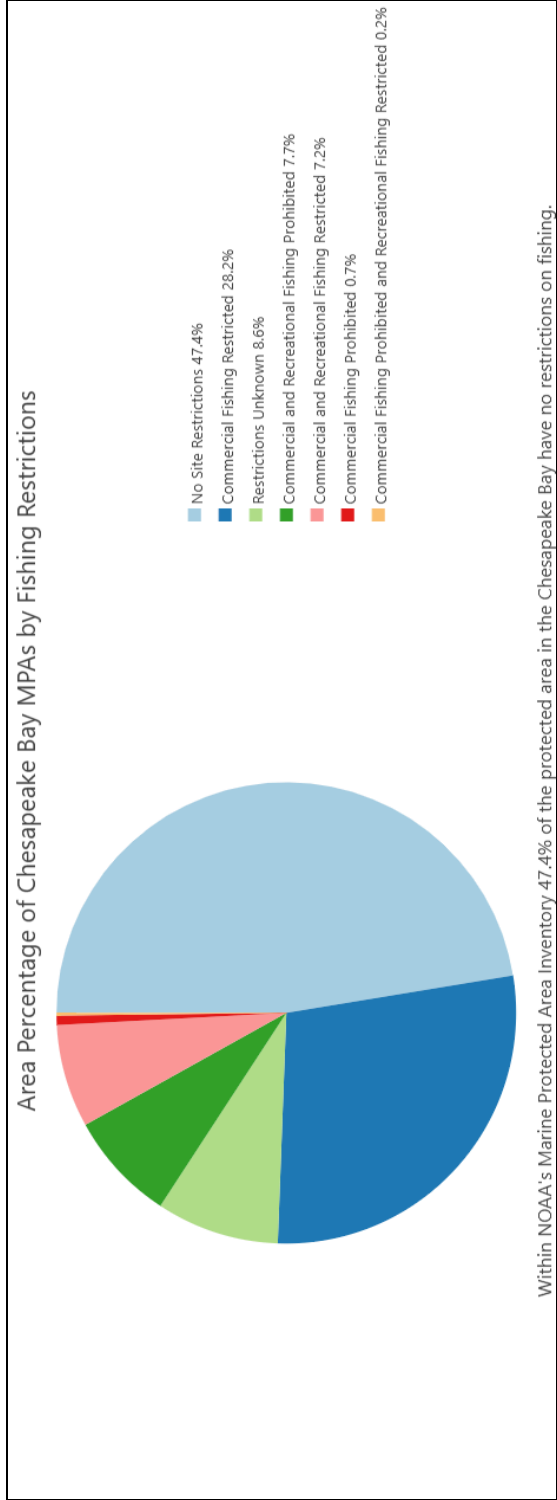
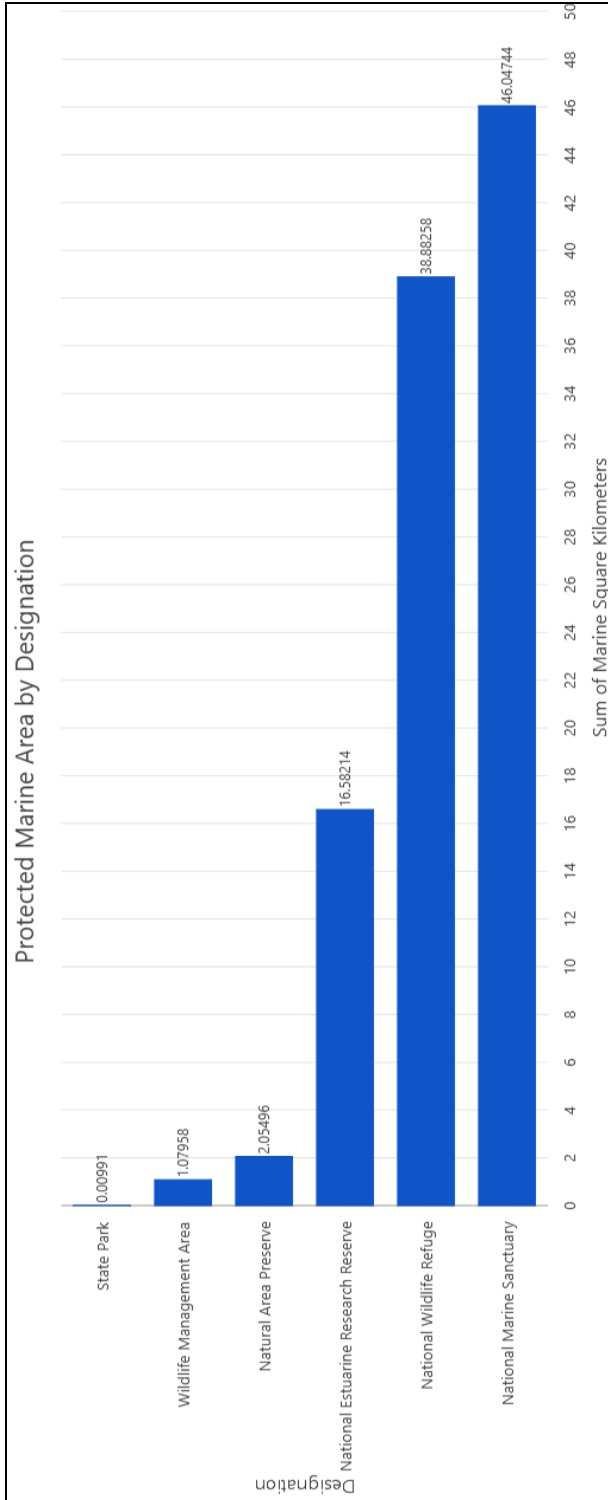
MPAs:

1. The extent of the [Chesapeake Bay's tidal region](#) was brought into the ArcGIS Pro environment and projected into the coordinate system "WGS 1984 Web Mercator (auxiliary sphere)".
2. A new attribute was added to the [Chesapeake Bay's tidal region](#) called "CalculatedArea" set as the numeric data type "double" and the ArcGIS Pro "Calculate Geometry" function was used to calculate the area of the polygon in square kilometers. The total square kilometers from this calculation was 11,864.760989 km².
3. [NOAA's MPA Inventory](#) was brought into the GIS environment, clipped to the extent of the [Chesapeake Bay's tidal region](#) using the "Pairwise Clip" geoprocessing tool, and projected into the coordinate system "WGS 1984 Web Mercator (auxiliary sphere)" using the "Project" geoprocessing tool.
4. A new attribute was added to the [NOAA's MPA Inventory](#) called "CalculatedArea" set as the numeric data type "double" and the ArcGIS Pro "Calculate Geometry" function was used to calculate the area of the polygons in square kilometers. These polygon areas were summed to get a total of 104.65661591585587 km².
5. Taking this number and dividing the whole marine area of the tidal region of the Chesapeake Bay (104.66 km² / 11,864.76 km²) the percent of marine area in the Chesapeake Bay that is under some sort of MPA (as defined by NOAA's MPA inventory) is 0.88%.
6. To calculate how much marine area restricts fishing, we utilize the NOAA MPA Inventory's field "Fishing Restrictions". The following categories' marine area were then summed:
 - a. "Commercial Fishing Prohibited and Recreational Fishing Restricted" (= 0.2 km²),
 - b. "Commercial Fishing Prohibited" (= 0.69 km²),
 - c. "Commercial and Recreational Fishing Restricted" (= 7.56 km²),
 - d. "Commercial and Recreational Fishing Prohibited" (= 8.07 km²), and
 - e. "Commercial Fishing Restricted" (= 29.49 km²)

The total area restricting fishing (sum of all categories) is 46.01 km² or 0.39% of the total 11,864.76 km² of marine area in the Chesapeake Bay. All fishing is prohibited ("Commercial and Recreational Fishing Prohibited"= 8.07 km²) in 0.068% of the marine area in the Chesapeake Bay.

Appendix D: Chesapeake Bay MPA Statistics





Within NOAA's Marine Protected Area Inventory 47.4% of the protected area in the Chesapeake Bay have no restrictions on fishing.