Testimony of
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Introduction

Good morning, Chairman Bentz, Ranking Member Huffman, and Members of the Subcommittee. I am a coastal geoscientist and associate professor at the Virginia Institute of Marine Science, William & Mary. It is an honor to testify this morning on the importance of coastal barriers. These landforms and associated ecosystems are at the core of my scientific expertise: I have been studying their physical evolution, modern processes and dynamics, and sensitivities to projected increases in storminess and rates of sea-level rise for nearly 20 years. My research includes sites across the U.S. and beyond, including East Coast barriers from Maine to Florida, with an emphasis in the last decade on the largely undeveloped system of barrier islands of Virginia's Eastern Shore.

My testimony serves to provide scientific background on coastal barrier systems, the buffer between the coastal ocean and mainland human population centers and infrastructure. These elongate, generally shore-parallel bodies of sand (barrier spits and islands) protect the mainland coast from coastal impacts of sea-level rise and devastating storms. Coastal barriers are found along ~15% of the world's coastlines, and nearly the entire U.S. East and Gulf coasts; in fact, nearly a full quarter of the world's barriers islands are found within the United States, accounting for ~6500 mi^2 of land area[1,2]. Together with their backbarrier estuaries, lagoons, tidal flats, and wetlands, coastal barriers serve as a natural storm buffer; include some of the most popular tourist and recreational destinations in the U.S.; provide habitat for a wide variety of wildlife, including threatened and endangered species, migratory waterfowl, and juveniles of recreationally and commercially important species; and sequester climate-altering carbon dioxide (CO_2) in the form of organic-rich "blue carbon" reservoirs. In short, as noted in the 1982 Coastal Barrier Resources Act, coastal barriers "contain extraordinary scenic, scientific, recreational, natural, historic, archeological, cultural, and economic importance." Protection of these dynamic, yet sensitive, coastal systems yield immense ecosystem, societal, and economic benefits, both measurable and intangible.

The Unique Role of Undeveloped Coastal Barriers

The 1982 Coastal Barrier Resources Act (CBRA) defines *undeveloped coastal barriers* "as:

A. a depositional geologic feature (such as a bay barrier, tombolo, barrier spit, or barrier island) that (i) consists of unconsolidated sedimentary materials; (ii) is subject to wave, tidal, and wind energies, and; (iii) protects landward aquatic habitats from direct wave attack; and
B. all associated aquatic habitats, including the adjacent wetlands, marshes, estuaries, inlets, and nearshore waters;

but only if such feature and associated habitats (i) contain few manmade structures and these structures, and man's activities on such feature and within such habitats, do not significantly impede geomorphic and ecological processes, and (ii) are not included within the boundaries of an area established under Federal, State, or local law, or held by a qualified organization as defined in section 170(h)(3) of the Internal Revenue Code of 1954, primarily for wildlife refuge, sanctuary, recreational, or natural resource conservation purposes."

These definitions largely follow those accepted within the scientific community. What is missing from this legal designation is the fact that coastal barriers are among the—if not *the*—most dynamic landforms on Earth. In their natural state, they are constantly undergoing reworking by waves, wind, and currents; they shape and reform in response to, and following, storm impacts; and, at any time, there are barriers undergoing long-term (decadal or longer) phases of progradation (widening), elongation, accretion, erosion (narrowing), breaching, or migration. Indeed, one can never visit the "same" barrier twice, as the landform and its associated habitats are constantly adjusting to ever-changing conditions at the intersection of land, ocean, and atmosphere. It is this dynamism that makes undeveloped coastal barriers such environmental oases, and it is the resilience of these systems—their ability to "regenerate" following major storm impacts—that makes them so vital to the protection of mainland communities and infrastructure.

Most barriers formed thousands of years ago, and often miles offshore of their present locations. Sea-level rise since that time has driven these landforms onshore, while during the same time the mainland behind them has flooded. This process of barrier rollover (landward migration) occurs largely through a process called "overwash", in which storm waves and surge overtop the barrier and transport its beach sand to the rear of the barrier and into the lagoon. It is this process through which these barriers (whether mainland-attached spits or offshore islands) maintain elevation above sea level. It is also what allows these coastal barriers to preserve and protect adjacent ecologically and economically rich backbarrier environments, characterized by extensive estuaries, lagoons, tidal flats, submersed aquatic vegetation, and intertidal wetlands (marshes and/or mangroves). However, this is just one of myriad services of coastal barriers and their associated backbarrier systems —particularly those which are undeveloped and allowed to naturally adapt to changing atmospheric and oceanographic forcings.

Coastal Barriers Provide Protection to Mainland Communities and Infrastructure

In the U.S., approximately 40% of the population lives in coastal counties[3], and there are 180 coastal municipalities along the coasts of the continental U.S. with populations of > 50,000 and land areas with elevations at or below about 20 ft above mean sea level[4]. Infrastructure within the coastal zone totals $3 trillion along the East and Gulf Coasts alone. Total insured property values for coastal states exceed $10 trillion[5]. And globally, many of the densest coastal population centers are within the world's six "hurricane belts", with that spanning the U.S. East and Gulf Coast having experienced the highest economic losses in the world due to storms[6].

Coastal barriers and their associated backbarrier lagoons and wetlands serve as a "speed bump" to storms as they approach the coast -- storms such as Hurricane Sandy in October 2012, or Tropical Storm Ophelia, which struck the Mid-Atlantic coast just this past weekend. It was the devastation of Hurricane Sandy that initiated the process of modernizing the Coastal Barrier Resources System (CBRS) (first established by the 1982 CBRA) along much of the U.S. East Coast through funding provided by the January 2013 Disaster Relief Appropriations Act (Public Law 113-2); these updated maps and recommendations were presented in a comprehensive 2022 Report to Congress authored by the U.S. Fish and Wildlife Service (USFWS)[7].

Some of the worst damage from Hurricane Sandy (2012) was along the coastal barriers that front the mainlands of New Jersey and New York. However, the impacts were not to the physical system of sand, mud, water, and wetlands that comprise the barrier systems: those are resilient; configurations may change as flood waters rise and fall, waves move sediment across the system, and tidal currents carve inlets, but the natural system persists. Undeveloped coastal barrier systems function under the rules of physics. Rather, the risk from these storm impacts lies at the intersection with human communities and infrastructure. And this is where coastal barriers and their associated backbarrier aquatic habitats play an indispensable role in mainland protection.

Coastal barriers and beaches bear the brunt of ocean storm waves during hurricanes and nor'easters, leaving only small, locally formed wind waves in backbarrier lagoons. Barriers greatly decrease wave heights, protecting mainland communities and reducing erosion of mainland and backbarrier marshes. By providing only narrow openings through which water can flow (tidal inlets), coastal barriers substantially retard the volume of water flooding adjacent backbarriers, reducing storm surge and attendant mainland flooding. Further, these coastal barriers support the presence of coastal wetlands, which themselves reduce wave energy and absorb floodwaters: they are estimated to hold an annual average storm-protective services value of ~$4.6 million/mi^2 (nationwide, ~$23 billion/year; ref. 3), with higher protective benefits in states with weaker building codes[8]. To wit, it is estimated that backbarrier wetlands reduced property damage from Hurricane Sandy by $567 million in New York and New Jersey alone[9]. The benefits were smaller but still profound distant from the epicenter of the storm's landfall. In Members Kiggans' and Wittman's homes of coastal Virginia, the protective value of wetlands (not all located behind barrier islands) from Hurricane Sandy is estimated at $10 million; and in Member Magaziner's district in Rhode Island, the value is $300,000[9].

Coastal Barriers Provide 'Ecosystem Services'

Beyond protective benefits for backbarrier and mainland communities, undeveloped coastal barriers provide and protect important habitats that sustain threatened and endangered species and maintain recreational and commercial fisheries. By intercepting dissolved and particulate matter from land and ocean, vegetation associated with coastal barrier beach and dunes acts as natural biofilters and support the breakdown of organic materials and pollutants. Those same dunes can temporarily store storm water. Beach and dune sands provide habitat that supports unique and diverse micro-, meso-, and macrofaunal communities including significant habitat and nesting sites for pinnipeds, sea turtles, shorebirds (including the endangered piping plover), and songbirds; and enhances species richness and diversity. In addition, coastal barriers protect wetlands and submersed aquatic vegetation beds that in turn serve as long-term carbon storage reservoirs, provide food resources to a wide variety of wildlife, including threatened and endangered species, migratory waterfowl, while at the same time serve as nursery habitat for larvae and juveniles of economically important species, such as bait and commercial fishes.

A Contrast with Developed Barriers

With ~2.3 billion tourists visiting annually, beaches (including those on coastal barriers) are the most popular tourist and recreational destinations in the country, contributing ~$357 billion (in 2023 USD) annually to the U.S. economy. Coastal states such as Alabama, Alaska, California, Florida, Hawaii, Louisiana, Oregon, Rhode Island, and Virginia receive 85% of annual tourism-related revenues in the U.S., supporting 2.5 million jobs and generating $45 billion in taxes[10]. However, coastal erosion—largely associated with storm impacts—affects ~85–90% of beaches in the U.S.[11] and is responsible for >$500 million per year in property damage, including land losses and structure impairments[12]. To counter this, developed barriers and beaches have received ~3600 sand nourishment projects, totaling ~1.7 trillion cubic yards, and at a cost of nearly $9 billion (91% since 1960)[13]. The vast majority (>83%) of these projects have been to beaches in California, Florida, New Jersey, North Carolina, New York, and Louisiana. Combined with hard and soft engineering approaches (*e.g.*, installation of seawalls, groins, jetties, breakwaters, etc.), this approach has largely prevented the natural landward movement of developed barriers towards the mainland, and migration of coastal wetlands onto uplands in response to sea-level rise. In fact, in many places, such as the New Jersey Shore, barriers have experienced net progradation (growth) in recent decades, because of repeated nourishments and shoreline hardening.

However, these shoreline-stabilization activities are racked with problems, ranging from ecological impacts to ever-increasing costs of a finite resource (sand), to racial and wealth inequities in application. For example, development disrupts the connection between barriers and their adjacent lagoons and wetlands, interrupting the natural, storm-induced landward transfer of sand that helps to sustain wetlands in the face of sea-level rise. Shoreline stabilization has been shown to further promote larger and more extensive development[14]. And, over the long term, activities required to support continued development and occupation of coastal barriers leave the barriers vulnerable to wholesale drowning and deterioration[15]. None of these challenges exist for undeveloped coastal barriers. Indeed, in addition to placing communities and infrastructure at risk, development on coastal barriers can remove many of the protective, economic, and ecosystem values of coastal barriers[16].

An Example from Virginia's Undeveloped Barrier Islands

Along the 70-mile-long seaside of the Eastern Shore of Virginia (located within Representative Kiggans' 2nd Congressional District) lies 13 largely pristine, undeveloped barrier islands. Only one of the ocean-facing islands has experienced any significant development: Wallops Island, home to the NASA Wallops Flight Facility, the Virginia Mid-Atlantic Regional Spaceport, and the Navy's Surface Combat Systems Center. Approximately 215 mi^2 (including >68 mi of beachfront) of these coastal barrier systems are protected from development by state and federal agencies and non-governmental organizations. These islands are home to The Nature Conservancy's Virginia Coast Reserve; a National Science Foundation Long-Term Ecological Research site; the Assateague National Seashore; and National Wildlife Refuges on Wallops, Assawoman, Chincoteague, and Fisherman islands.

These islands, along with the lagoons, wetlands, and mainland Eastern Shore they support and protect contain ~$14 billion in coastal infrastructure and $15 million/yr shellfish aquaculture and fisheries industries[17]. The total annual spending associated with tourism at the Chincoteague National Wildlife Refuge (largely located on the undeveloped Assateague Island) is estimated at $315 million, supporting 3766 jobs[18]. The local clam aquaculture industry exceeds $61 million/year and supports nearly 700 jobs[19].

The undeveloped coastal barriers of the Virginia Eastern Shore provide ample protective and ecological benefits to the communities, ecosystems, and economy of the Eastern Shore. As one of the last remaining expanses of coastal wilderness on the Atlantic, the coastal barriers of the Eastern Shore are a conservation and restoration jewel. This region boasts recognition as a United Nations International Biosphere Reserve, a U.S. Department of the Interior National Natural Landmark, a Western Hemisphere International Shorebird Reserve Network Site, and an Atlantic Coast Joint Venture Focus Area. The islands themselves provide habitat, nesting, and feeding grounds to over 250 species of raptors, shorebirds, and songbirds[20]. The adjacent lagoons are host to approximately 60 acres of restored oyster reef; 2000 acres of oyster reef sanctuaries; 5000 acres of restored eelgrass meadows (the largest seagrass restoration project in the world); and the reintroduced bay scallop. Additionally, saltmarshes and seagrass beds protected by the fronting barriers reduce the volume of water moving towards the mainland by up to 15% during normal tidal cycles, and more during storms[21].

The protective, economic, and ecosystem value of the Virginia Barrier Islands is owed largely to the fact that they are *undeveloped*. These barriers move landward at rates of > 20 feet/year, largely in response to storm-driven overwash. The cost to taxpayers of this dynamic movement? Next to nothing. Along heavily developed barriers of large portions of the New Jersey, North Carolina, Florida, and Gulf coasts, storm impacts flood islands and work to move them landward, creating a problematic and deeply costly scenario for the populations and infrastructure of those islands. In contrast, the wind, waves, and floodwaters that strike the Virginia Barrier Islands are felt only by the sand and vegetation of those islands (in most cases): the islands move and adapt, receiving the brunt of the storm and protecting the mainland and ecosystems landward of the islands. This allows these undeveloped coastal barriers and the ecosystems they support to remain conservation jewels, with benefits for the citizens of the Commonwealth today and into the future.

The Future of Coastal Barriers: Expanding the Coastal Barrier Resources System through the BEACH Act

Human-induced climate change presents an immediate threat to coastal communities worldwide. As a result, the value of the protective services of barriers and associated wetlands is projected to increase with accelerating climate change and growing development pressures. The threat to coastal systems and communities grows annually not only because increasing of accelerating rates of sea-level rise and increases in storm frequency and intensity, but also because of increasing population density and coastal infrastructure placed within high-risk coastal zones. For example, between 1970 and 2010, coastal shoreline counties added 3.5 times more people per square mile than the nation as a whole[12]. Along the U.S. East Coast, these new residents are challenged with some of the highest rates of sea-level rise in the country; in the Mid-Atlantic specifically, they are more than twice the global average, already leading to widespread "sunny day" and recurrent nuisance flooding. Coupled with hurricanes and nor'easters, these impacts are likely to cost billions of dollars in property damage in the U.S. by mid-century, with accelerated risk in the Mid-Atlantic[22]. The threats are widespread, including to developed coastlines, built infrastructure and hardened landscapes, agricultural lands and forest ecosystems, and groundwater resources. Importantly, many of these changes will occur irrespective of the unlikely immediate reduction in CO_2 emissions that is required to slow the pace of climate change. For example, Mariotti & Hein (ref. 23) found that undeveloped barriers are primed for rapid migration, even in the highly improbable case in which sea levels stabilize at current elevations. The case is more dire along developed coasts, where stabilization of many open-ocean beaches as well as upland coastal margins (*e.g.*, marsh-forest boundaries) will fundamentally impact coastal ecosystem size and functionality, leading to reduced and deteriorating coastal habitats and attendant protective and ecosystem services[24].

The CBRA established the Coastal Barrier Resources System (CBRS), encompassing ~3.5 million acres along the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto

Rico coasts. The CBRA established a "program of coordinated action by Federal, State, and local governments . . . critical to the more appropriate use and conservation of coastal barriers." As a result of this Act, development rates and densities of hazard-prone coastal areas substantially decreased[25], and 97% of all CBRS units remained undeveloped or have experienced minimal development[26], allowing them to continue to serve their full potential for coastal protection and habitat. Further, federal expenditures associated with coastal disasters were decreased by ~$9.5 billion, and forecasts are that—without any substantial changes to the CBRS system—the fiscal benefits of the CBRA over the next 50 years will be more than ten times greater than historical benefits: depending on land development patterns and rates and storm impacts, the CBRA is likely to contribute between $8.6 and $63 billion in disaster-relief savings by 2048, and between $11 and $109 billion by 2068[27].

The Bolstering Ecosystems Against Coastal Harm (BEACH) Act seeks to give congressional approval to update the CBRA System using new and detailed mapping undertaken by the USFWS following Hurricane Sandy. Additionally, the bill makes improvements to CBRA that make it more transparent and flexible. As detailed in the USFWS report[7], these goals will be accomplished through:

- removal from the CBRS of 969 acres of land above mean tide ('fastland') and 392 acres of wetlands and open water that were apparently mistakenly included in the original Act.
- addition to the CBRS 11,102 acres of fastland and 266,848 acres of associated aquatic habitat, including 3,240 acres of privately owned fastland.
- net reclassification of 28,956 acres from System Unit to 'Otherwise Protected Area'.

Together, these changes would add a net 276,589 acres to the CBRS, expanding it to a total of 846,918 acres of protected, largely undeveloped coastal barrier and wetlands. Doing so would allow for continued and expanded maintenance of coastal barrier systems, such as those along Virginia's Eastern Shore, in an undeveloped state. This will allow them to adapt naturally to sea-level rise and will help ensure their continued roles in supporting coastal economies, recreation, and tourism; providing habitat and myriad ecological services; protecting mainland communities and infrastructure; and offering vital opportunities for scientific research and education.

Conclusion

I have herein carefully limited my testimony to scientific facts: the myriad roles of coastal barriers and the increasing threats they face from climate changes. My intent is to lay out the tremendous protective, economic, and ecosystem benefits provided by coastal barriers and their associated estuaries, lagoons, tidal flats, and wetlands; services which the science is clear are enhanced through policies that allow those to remain in their most natural state. On behalf of the Virginia Institute of Marine Science, William & Mary, the coastal scientific community, and the citizens of coastal Virginia, I am grateful for the Subcommittee's interest in expanding protections for these vital landforms and ecosystems based on the best-available science from the USFWS, and welcome any questions or concerns.

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