

Testimony for the House Select Committee on the Climate Crisis
on
America's Natural Solutions: The Climate Benefits of Investing in Healthy Ecosystems

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Chair Castor, Ranking Member Graves, and members of the Select Committee:

Thank you for inviting me to testify today and your willingness to listen and learn of new solutions to address the impacts of climate change – solutions that improve our coastal habitats, strengthen our communities' ability to withstand adverse environmental conditions, and increase America's Blue Economy. My name is Sherry Larkin, and I am a professor in the Food and Resource Economics Department at the University of Florida and serve as the Director of the Florida Sea Grant College Program. In my testimony I will describe several ongoing projects and conclude with an identification of the suite of tools and skills that can help ensure natural solutions are effective at helping mitigate the negative environmental and economic effects of climate change.

I would like to begin by providing some context. As an economist specializing in ways to measure the value of natural resources, I am thrilled to see the growing scientific literature that estimates the economic value of our nation's natural capital – and a genuine interest from resource managers and policy makers committed to ensure those values are sustained, and perhaps even grow with targeted investments. Our nation benefits greatly from our natural environment – from our watersheds that start high in the mountains, across the plains, and out to the end of our Exclusive Economic Zone 200 miles offshore. These environments have consistently worked to protect our shorelines, diffuse and dilute our wastes, remove excess nutrients from our land-based activities, and excess carbon from our atmosphere, but we are outgrowing the capacity of these environments to protect us and clean up after us. As our growing scientific literature is helping us understand just how much our natural environment has helped us to adjust to climate change, it is now time for us to partner fully with that environment to improve the resilience of our coastal areas moving forward.

As the Director of the Florida Sea Grant College Program, which is one of 34 university-based programs nationwide. Our network generates solutions for the issues affecting our Nation's coastal communities throughout the Atlantic and Pacific (including the Great Lakes and Gulf of Mexico), yielding quantifiable economic, social, and environmental benefits. The National Sea Grant College Program Act of 1966 authorizes our funding for research, education, and advisory services in any field related to the conservation and development of marine resources. Sea Grant is a unique program within the National Oceanic and Atmospheric Administration (NOAA) under the Department of Commerce. We are charged with not just funding research but ensuring that those findings are communicated to the public and used by resource managers and coastal communities and businesses. We operate across line offices in NOAA and across state and federal agencies in support of our broad mission. A joint federal, state, and county investment, Sea Grant competitively awards over 90% of appropriated funds to coastal states through

issues identified locally with boots-on-the-ground extension specialists and science communicators who live in the communities they serve. You can find more information on Sea Grant in the Sea Grant Association's Programmatic Request for FY2023 (<https://bit.ly/sgaprogrammaticask>), including planned efforts to extend and upscale efforts to improve coastal resilience that we are discussing today. Every dollar of federal investment in Sea Grant must be matched with \$0.50 of non-federal investment, which is a model that fosters cost-effective and collaborate efforts. As a network, we have documented investments of more than six times the required match.

In 2020, the Sea Grant program helped generate an estimated \$520 million in economic benefits, created or supported 11,044 jobs, created or sustained 1,332 businesses, assisted 285 communities improve their resilience, helped restore or protect an estimated 4.2 million acres of habitat, and supported the education and training of 2,027 undergraduate and graduate students (NSGO, Fall 2021). Aside from metrics of accomplishment, Sea Grant programs are trusted sources of scientific information and occupy a neutral, partner-building space at the community level; we are neither regulatory nor fundraising-focused and have a 50-year track record. That consistent presence and support, often in conjunction with our Land Grant partner institutions, provides an invaluable link between the terrestrial and aquatic ecosystems that help us be particularly effective.

Today, I appreciate the opportunity to speak about the climate benefits of investing in healthy ecosystems, with a focus on coastal and marine ecosystems. While discussing the ecosystem services associated with forest or agricultural lands is understood by many, the physical processes of the ocean are not as observable – and yet, our oceans are undeniably our biggest asset in the fight against climate change. Coastal marine ecosystems – mangroves, tidal marshes, and seagrasses¹ – sequester and store large quantities of carbon in both the plants and the sediment below. In fact, all carbon in seagrass meadows is stored in the soils, which is why the mounting concern over loss of seagrasses in Florida is more than just for manatees.

According to The Blue Carbon Initiative (<http://thebluecarboninitiative.org>) 83% of global carbon cycle is circulated through the ocean, and coastal habitats account for approximately half of the total carbon that is deposited and stored (i.e., sequestered) in ocean sediments. This means there is opportunity to invest in coastal habitats, which currently only account for less than 2% of the total ocean area. That is the ideal scenario, that we only need to invest in more habitat and rely on photosynthesis and the potential that all plants have to regenerate and support sustainable industries, including plants from the ocean. Which is why Sea Grant has “Healthy Coastal Ecosystems” as one of four National Focus Areas and has invested in habitat restoration as mentioned with the metric previously. Florida is no exception; we have grown and replanted new seagrasses, mangroves, and shoreline sea oats, and we have even invested in genetic studies to create more effective plant varieties. Plant breeding is not just for food and fiber crops, and could become a more important tool as we learn that not all marine vegetation is a net carbon sink because the reality is that respiration releases carbon dioxide. Moreover, if these areas natural areas are disturbed – such as scarring by boat motors or excessive trimming by oceanfront

¹ Seagrasses are not grasses, they are flowering plants more akin to land-growing lilies or ginger. Their leaves are thin but strong and flexible, which allows the plant to withstand constant movement from waves and currents; the same movement also disperses their seeds and pollen (like land-based plants use bees and wind for pollination). Seagrasses have evolved to grow on the soft, sandy seafloor through a vast network of roots and specialized branching stems that act as anchors and stabilize the sediment.

homeowners – these coastal ecosystems will release the carbon they have stored (which could have been for centuries for native habitat), and that carbon returns to the atmosphere and contributes to greenhouse gasses that are responsible for global warming, rising seas and ocean acidification.

As this example shows, we also need research on plant biology and breeding to maximize the carbon uptake and growth potential. We also need public education programs, like our “Seagrass Safe Boating” that has recreational boaters take a pledge (<http://beseagrasssafe.com/>) and “Mangrove Trimming Best Management Practice” videos that show the how and why (<https://edis.ifas.ufl.edu/publication/FR448>). In these programs, we are not only seeking that the public gain knowledge, we are also providing the education to make them act and change their behaviors. And that education extends to other efforts that will help maintain the integrity of natural systems, such as removing invasive species (e.g., beach vitex is a wonderful ornamental, but kills native sea oats and is without the root structure needed to stabilize shoreline dunes; <https://blogs.ifas.ufl.edu/escambiaco/2018/06/24/an-unwanted-invasive-plant-beach-vitex/>). For some communities, the urgency has led to local ordinances where violations result in fines. Thus, sound policy and regulation could be another mechanism to help maximize atmospheric carbon removal.

But there is more good news. In addition to the carbon sequestration generated from photosynthesis, our oceans help us remove carbon dioxide from the atmosphere through calcification; that is, as carbon is absorbed from the ocean, the shellfish secretes calcium carbonate to form its shell (<http://oceanacidification.wordpress.com/2008/04/24/can-seashells-save-the-world/>), which means a percentage of shells contain carbon. The calcification process thus provides a permanent conversion of carbon dioxide into an insoluble mineral. In other words, the calcium carbonate from shellfish and in particular bivalves like oysters, clams, scallops, and mussels can persist indefinitely as limestone. This is promising: molluscan shellfish aquaculture has two products—food for humans and long-term storage of greenhouse gases. In contrast, the carbon contained in most plant and animal tissues return to carbon dioxide in a few years. Moreover, shellfish aquaculture practices do not produce merely the shell-bearing animals (such as oysters and clams with commercial value), but there are additional hard materials associated with external growth (often known as “biofouling”) that is costly for farmers to remove but beneficial for society due to its carbon capture properties. The post-consumption shells are an industry byproduct with value in construction, restoration, and potentially even for making decorative tiles like a partner institution in South America. However, just because there are carbon sink properties, and other societal benefits, does not mean that research is no longer needed. The lead author of a recent study concluded that, “If you want to create jobs and income, grow oysters to feed people and provide habitat for other species, and that can be done anywhere that’s suitable to oyster reef development. But if you want to sequester carbon, near shore is the best bet.” (Fodrie et al. 2017). In short, location matters.

Sea Grant, especially in Florida, has long provided outreach support to individuals that want to become shellfish growers, but from the perspective of supporting a financially sustainable and profitable industry. This support includes the provision of habitats, in part through assisting in the permitting and licensing process, and potentially the need to protect the juvenile shellfish from predation. We are now seeing the opportunity to manage growing operations with environmental benefits in mind. Farming in the sea doesn’t require irrigation, food, or fertilizer, but does require planning, permitting, and education that is not readily available or passed down between generations. And for new crops and shellfish products (<https://shellfish.ifas.ufl.edu/sunray-venus-clams/project-venus/>), Sea Grant has also

helped introduce consumers and chefs to these new supplies so marketing can also be a tool to promote growth in carbon sequestering shellfish production.

So far, I have focused on the potential carbon sequestration benefits of shellfish aquaculture, but I would be remiss to not share that these systems also provide equal promise in removing excess nutrients, like nitrogen, and there is tremendous potential to foster a nutrient credit trading program. To that end, Florida Sea Grant recently used COVID-19 relief funding to purchase market sized clams that have sized out of retail markets for their nutrient management functions and monitor those functions under a research experiment (<https://www.flseagrant.org/clams/> and <https://blogs.ifas.ufl.edu/news/2019/12/09/uf-researchers-team-up-with-florida-aquarium-for-noaa-project-part-of-coral-reef-restoration-initiative/>). While this practice – of having multiple and complementary markets for hard clams – would seem the ideal solution, current regulations prohibit this practice, which is a long way of saying that permitting and regulatory revisions could be a prudent investment as efforts like the new “All Clams on Deck” (<https://www.allclamsondeck.org/>) develop. The development of such programs would mimic efforts proposed by USDA for land-based agriculture, such as the Partnerships for Climate-Smart Commodities (<https://www.usda.gov/climate-solutions/climate-smart-commodities>) or those of Solutions for the Land (<https://www.solutionsfromtheland.org/flcsa/>), dubbed a “renaissance” in production with a focus on innovation, entrepreneurship, and advanced environmental sustainability objectives.

Now you might be thinking, what about other invertebrates such as corals, sponges, and sea urchins? In fact, Florida Sea Grant is investing in all three with a focus on restoration (e.g., https://www.flseagrant.org/wp-content/uploads/SGEF_215_SpongeRestoration_web.pdf and <https://blogs.ifas.ufl.edu/news/2019/12/09/uf-researchers-team-up-with-florida-aquarium-for-noaa-project-part-of-coral-reef-restoration-initiative/>). At first glance, it would seem obvious that other invertebrates also might serve as carbon “sinks” (i.e., net consumers of carbon). In fact, like shellfish and seagrasses, the benefits are driven by a multitude of factors that justify the need for both theoretical and applied (site-specific) research to identify, measure, and ultimately document the net carbon effects of habitat restoration efforts (especially in regards to current water quality conditions).²

Augmenting and extending habitats through targeted species-specific restoration, incentivizing, and promoting the growth of shellfish that absorb atmospheric carbon can only take us so far, which is why we’ve moved toward the development, training, and practice of “Living Shorelines” or LSLs. A “Living shoreline” (<https://floridalivingshorelines.com/>) is a broad term used to describe a range of nature-based approaches to stabilize a shoreline. In suitable environments, living shorelines can be used instead of seawalls or bulkheads to reduce erosion and protect property. Living shoreline projects are made up of mostly natural materials, such as native wetland vegetation, natural fiber logs, or oyster reef breakwaters, thus maintaining natural shoreline features – and utilizing the carbon sequestration properties of the plants and shellfish. In Florida, these configurations predominantly utilize salt marshes, mangroves, and oysters (<http://floridalivingshorelines.com/types-of-living-shorelines/>). According to NOAA, a living shoreline is:

² The scientific evidence is clear on the value of preserving and restoring coral reefs aside from carbon sequestration (<https://www.nature.com/articles/ncomms4794>, and <https://www.nature.com/articles/s41893-021-00706-6>). Benefits include reducing coastal flooding and associated damage to infrastructure and loss of human life, and there are several promising innovations that could translate to other invertebrates.

"A shoreline management practice that provides erosion control benefits; protects, restores, or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g. biologs, oyster reefs, etc.)." (<https://shoreline.noaa.gov/glossary.html#partj>)

As you have likely surmised, every LSL should be the result of thoughtful, careful consideration of each project site and strategic placement of natural components along the shoreline profile. As a result, coastal property owners have a menu of potential solutions available for solving erosion problems – it's not just seawalls anymore! And, in fact, every site needs a "green-to-grey" assessment to determine the range of vegetation, edging, sills, breakwater structures, revetment and bulkheads that are most suitable. Sea Grant has attempted to foster the adoption of this technique (and seawall replacement) by both educating homeowners³ and by developing a workforce training module – dubbed the Marine Contractors training (<https://blogs.ifas.ufl.edu/ncbs/2021/01/07/living-shorelines-for-marine-contractors-virtual-course-this-month/>) to foster development of a new industry and upscale efforts to combat atmospheric carbon.

This homeowner education program was recently recognized at the national level by the Association of Natural Resource Extension Professionals (ANREP) and received the Gold Award in the Outstanding Educational Materials category for a Book or Comprehensive Program Curriculum for the *FMNP Marine Habitat Restoration Special Topics Course*. The program provides detailed information on the ecology, benefits, restoration methods, and monitoring of marine habitats in Florida. A team of six faculty created the course curriculum, focused on restoration of seagrasses, coral reefs, sponges, and marine enhancement through artificial reefs. The companion video series consisting of four videos, each between 10 and 26 minutes long also garnered the Silver Award for the TV and Video category.

With the goal of shoreline restoration, it might be easy to overlook that the methods and materials matter. Sea Grant is committed to also helping clean nearshore and offshore aquatic systems, including from plastics. We have a long-standing micro plastics awareness program (<https://flseagrant.ifas.ufl.edu/microplastics/>) and strive to reduce the use of plastics in our own programs. One example is PROS – a Partnership for Plastic-free Restoration of Oyster Shorelines (<https://blogs.ifas.ufl.edu/ncbs/2021/09/03/a-partnership-for-pros-plastic-free-restoration-of-oyster-shorelines/#:~:text=This%20project%20is%20called%20the,free%20material%20called%20reef%20prism s.>). This partnership resulted from faculty research project that sought to improve upon the most common LSL configuration, that is, creating reefs by stacking up rows of "shell bags" (oyster shell contained in plastic nylon mesh sacks). Given that the bags can release microplastics into the marine environment, researchers sought a new design and Reef Prisms were born. This new design uses jute fiber instead of plastic and an adhesive that is free of additives and readily available from local big box stores; an outcome that reduces costs, increases availability of materials and helps local economies – in addition to providing an alternative career path. You see, the development of a Blue Economy is also an unprecedented opportunity for workforce development and mechanism to help address diversity, equity and inclusion objectives at the community level; if we don't consider the opportunity now, the Blue economy could leave the underserved even further behind.

³ The FMNP includes two courses, each with 24 contact hours, developed by Florida Sea Grant Extension agents that increase education of restoration (<https://masternaturalist.ifas.ufl.edu/become-a-master-naturalist/master-naturalist-courses/>): (1) Coastal Shoreline Restoration, and (2) Marine Habitat Restoration.

I hope you are beginning to see the value of LSLs for both the environment, coastal property owners, and coastal economies. Investments in habitat restoration improve the health of coastal ecosystems and reduce coastal waves and erosion that mitigate the economic impacts of sea level rise – and they do it at a much lower cost. But to make those projects come to fruition, we need local programs, communities, and planners to learn about their potential. Sea Grant has worked hard, through its boots-on-the-ground outreach, to engage with the public and local planners. For example, we have a Climate Smart Floridians program (<https://sites.google.com/ufl.edu/climatesmartflorida/climate-smart-floridians-program>) to provide citizens research-based information about climate change and engage them as volunteers to help reduce household expenses and personal greenhouse gas emissions; topics include landscaping, water resources, transportation, home energy, food and waste and highlights the impacts of individual choices on climate change. And one of our agents works closely with the Tampa Bay Regional Planning Council and is a member of their Technical Advisory Committee; those efforts have resulted in the development of a shoreline suitability model for the siting of LSLs. Working directly with communities has also been the objective of projects designed to develop flood resilient upgrades to natural buffers around transportation corridors near the Space Coast. Such projects change the aesthetics of an area and, as such, need local resident support and policy makers willing to invest in new designs. Finally, the Gulf Sea Grant programs have partnered with local organizations and agencies for more than a decade in hosting an annual climate “community of practice” meeting where we bring together scientists, outreach professionals, and local leaders and decision makers to identify solutions to climate related challenges facing communities today and anticipated to impact them tomorrow.

So, this is a great story of a win, win, win scenario for the environment (and all its natural dependents), the public that lives on or near coastal areas, and the entire nation’s economy as costs (and lives) are saved. The reality is that to generate societal benefits, a lot of pieces need to be in place – other than just funding the growth and replanting or stocking of plants and animals – namely:

- Site specific research on the physical and biological sciences behind carbon capture, storage, and release – for living shorelines and its component species such as seagrasses and shellfish to inform the development of interventions that includes:
 - quantifying the net carbon effects,
 - estimating the feasibility and economic values of alternative solutions, and
 - advises on the needed policies and or regulations.
- Education to students to encourage careers in natural coastal solutions to climate change and homeowners, policy makers, and relevant industry sectors with the goal of behavioral change.
- Training and workforce development to upscale our capacity to grow and support a new Blue economy that benefits all Americans, and especially the underserved.

Thank you for allowing me the opportunity to share the accomplishments, priorities, and ongoing activities of our Sea Grant program. You can find more information on many of the projects I described through links in the written testimony, but if you should have more questions or desire more information, please feel free to contact me directly. As a final caveat, as a program that is charged with (and embraces) developing partnerships to leverage resources, I speak on behalf of not just Florida Sea Grant, or the network of Sea Grant programs nationwide, but for all of our partners in these efforts since we do none of this alone. And I thank all of our unrecognized partners at this time.

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