The Economic Benefits of South Carolina's Beaches and Barrier Islands

2021 ASSESSMENT BY THE S.C. SEA GRANT CONSORTIUM

S.C. SEA GRANT CONSORTIUM
Coastal Science Serving South Carolina

Prepared by Matt Gorstein,
Coastal Economics Program Specialist

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South Carolina's Beaches and Barrier Islands

South Carolina's beaches and barrier islands produce a wide variety of benefits, contributing to the culture, lifestyle, and well-being of its residents. South Carolina boasts an impressive 35 barrier islands (second only to Florida in number). These barrier islands include beaches and associated habitats such as wetlands, sand dunes, and maritime forests (Figure 1). South Carolina's beaches and barrier islands provide its residents and visitors with jobs, recreational opportunities, coastal protection, critical habitat for bird and turtle species, and aesthetic beauty, among other environmental goods and services.

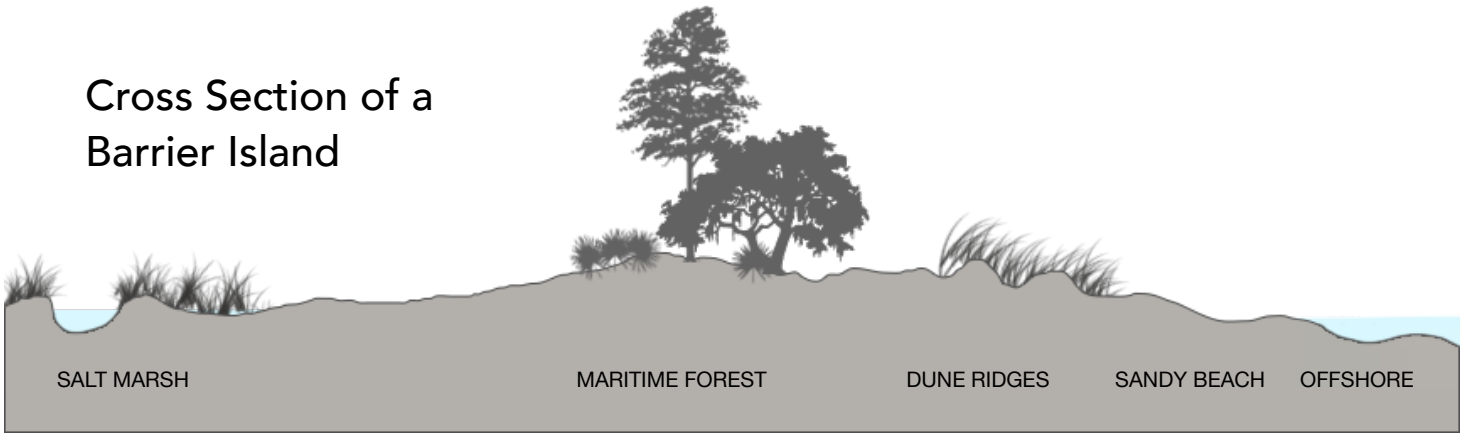

Figure 1: Barrier Island Cross-Section (Source: SC DHEC-OCRM)

Ecosystem Services

Environmental goods and services produced by ecosystem functions are often described as "ecosystem services." Ecosystem services refer to the benefits that humans get from nature. These may be direct services like fish and oysters being eaten, or indirect services such as providing protective buffers against storms and flooding. Coastal communities are dependent on the flow of ecosystem services to support economic activity.

Several important science and policy scholars have called for incorporating ecosystem service values in decision making related to land uses, development, and ecological restoration. For instance, sand dunes provide a buffer against storm surge, stabilize popular beach recreation areas, provide habitat for turtles and birds, and produce scenic beauty. The challenges of incorporating values related to these types of benefits in decision making include defining, classifying, and communicating those ecosystem service values, the perception that ecosystem services are not as important until after they are lost, and measuring social benefits, among others. Most environmental decisions involve the assessment of numerous different kinds of benefits compared to the costs of a proposed action. However, these benefits and costs are not adequately understood or measured in most cases, therefore the incorporation of ecosystem service values in decision making has the potential to produce more socially optimal outcomes.

The economic benefits provided by beaches and barrier islands can be both market and non-market-based measures. Market-based data (e.g. prices, wages, gross domestic product) are widely available for beach-related industries like commercial fisheries and tourism through agencies like the National Oceanic and Atmospheric Administration (NOAA) and the South Carolina Department of Parks, Recreation, and Tourism (SCPRT). However, there are other economic benefits provided by South Carolina's beaches and barrier islands referred to as "non-market" benefits, including things like coastal protection, carbon storage, water quality, and biodiversity (Figure 2). In order to estimate these types of benefits, non-market economic valuation techniques must be used. It is important to document both market and non-market economic benefits so that we can gain a more holistic understanding of the benefits derived from South Carolina's beaches and barrier islands.

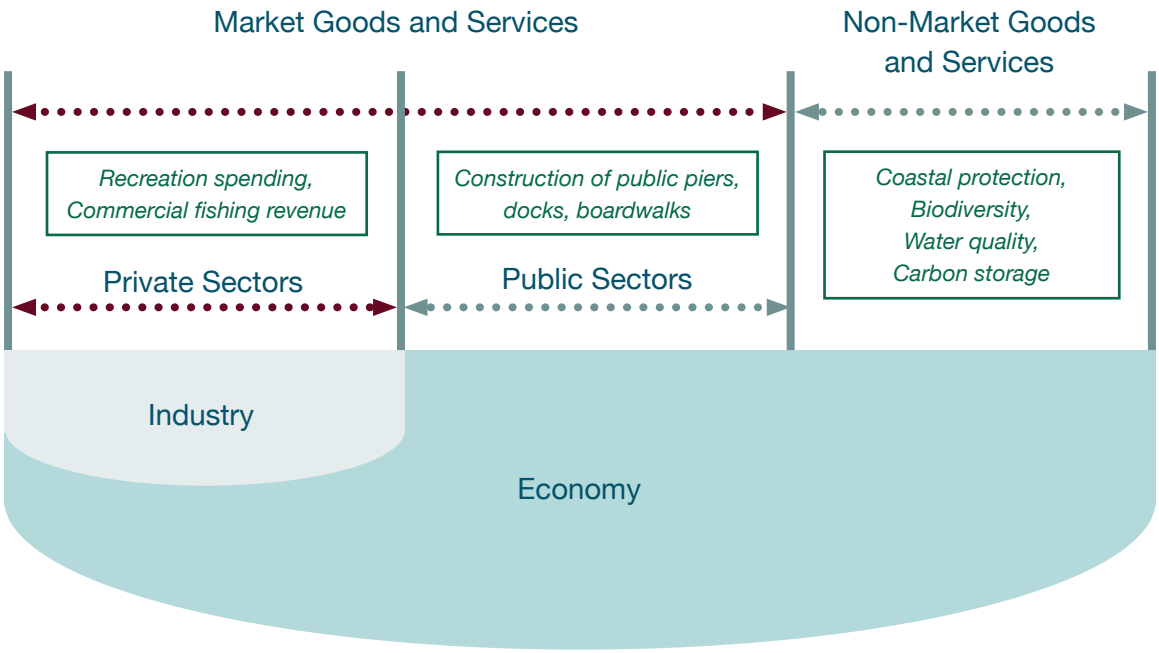

Figure 2: An Economy is Comprised of Market and Non-Market Benefits (Park and Kildow, 2015)

An investigation of existing data and past research was conducted to better characterize the estimated economic benefits of South Carolina's beaches and barrier islands, including both market and non-market benefits. This is commonly referred to as a "benefit transfer," selecting studies relevant to the South Carolina coast and using them to suggest values that are appropriate for the region. Standard best practices for conducting a benefit transfer are followed in this assessment. Through this method, an ecosystem service framework is utilized to estimate the economic benefits of beaches and barrier islands in South Carolina, at statewide scale. It must be noted that this assessment is based on what data and information are currently available, and does not capture every single economic benefit that is provided by beaches and barrier islands in South Carolina. As new information becomes available, there is potential to expand upon the information contained in this assessment to explore and estimate other types of economic benefits.

Study Area

This assessment is focused on South Carolina's beach and barrier island ecosystems. The beach and barrier island ecosystems contain wetlands, maritime forests, sandy beaches, and dunes. Since wetlands extend far beyond coastal areas in South Carolina, an analysis was conducted to estimate the area of wetlands associated with South Carolina's beach and barrier island ecosystems, in order to estimate ecosystem service benefits for these specific areas. Figure 3 shows the study area for this assessment, containing all of South Carolina's beaches and barrier islands, along with the 71,532 hectares of wetlands within these ecosystems (USFWS, 2018).

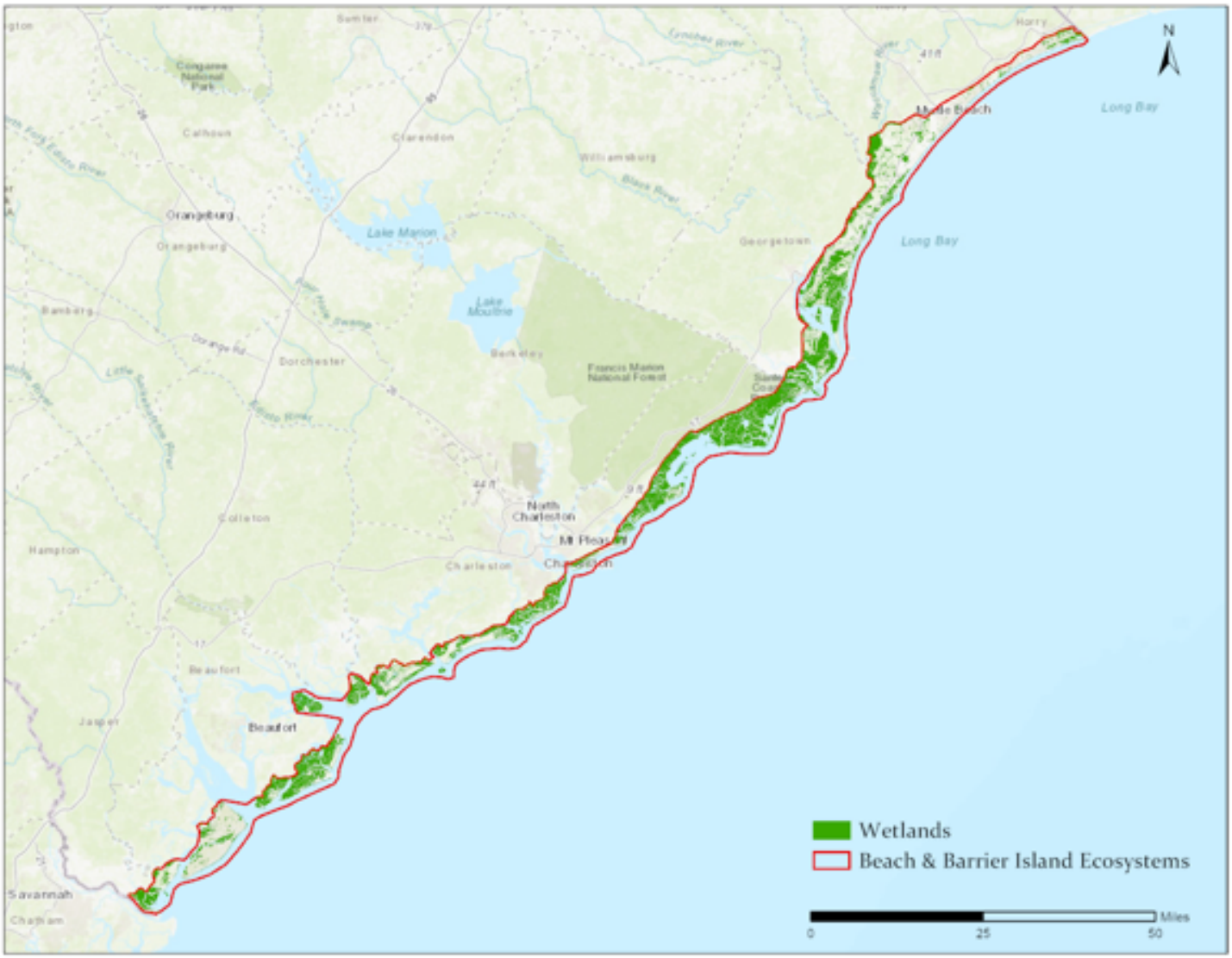

Figure 3: Map of wetlands associated with beach and barrier island ecosystems in South Carolina

Assumptions

It is important to note that this is an examination of economic benefits, as opposed to economic values. Economic values are "net" measures, taking both benefits and costs into account, measured by consumer surplus (the maximum price or amount of money that someone is willing to pay for a good or service minus its market price) and/or producer surplus (the market price of a good or service minus the minimum amount the producer is willing to accept). Economic benefits are "gross" measures that do not take costs into account (e.g. costs related to beach renourishment, costs related to sea turtle conservation). The purpose of this assessment is to get us closer to answering the question: "What are the economic benefits of South Carolina's beach and barrier island ecosystems?"

The list of ecosystem services examined in this assessment include:

1. Recreation
2. Coastal protection due to wetlands
3. Sea turtle habitat
4. Carbon storage
5. Water quality protection
6. Water supply protection
7. Property value enhancement (e.g. amenity benefit)

Other ecosystem services provided by beaches and barrier islands not addressed in this assessment, due to a lack of data and information appropriate for South Carolina, include:

1. Coastal protection due to sand dunes
2. Erosion control
3. Air quality enhancement from sand dune and wetland vegetation
4. Shorebird habitat
5. Nursery habitat for nutritionally and commercially important fish and shellfish
6. Cultural values

Therefore, the final economic benefit estimates that are presented can be considered conservative estimates for the total economic benefits provided by beaches and barrier islands in South Carolina. For a more detailed explanation of methods used to estimate benefits, please see the associated document. Each ecosystem service benefit that is estimated is discussed below, with associated lower and upper bound estimates. The reason for providing a range of upper and lower bound estimates is to acknowledge the unavoidable margin of error associated with using the benefit transfer method in estimating values for ecosystem services (Figure 4). Investigating studies that estimate value ranges and those that use different methods to quantify ecosystem service benefits provides more context than using a single value.

All dollar figures are adjusted to year 2019 dollars using the Travel Price Index (TPI) for recreation (US Travel Association, 2020), and the Consumer Price Index for all urban consumers (CPI-U) for all other services (US BLS, 2019).

Each ecosystem service benefit is expressed as a range of values, noting the margin of error associated with the benefit transfer method

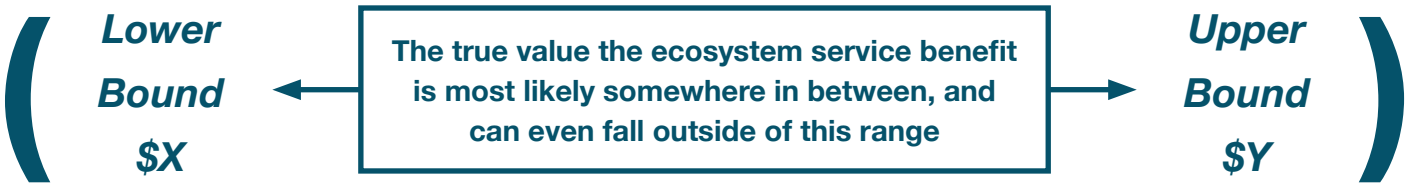

Figure 4: Benefit Transfer Upper and Lower Bounds

Recreation

In 2018, SCPRT estimated that approximately 33.8 million domestic visitors (originating from both in-state and out-of-state) came to South Carolina, spending approximately 125.1 million visitor-days (SCPRT, 2019a). Statewide tourism expenditures reached over $14.4 billion in 2018, and 65% of this was spent in the eight coastal counties (Horry, Georgetown, Charleston, Dorchester, Berkeley, Beaufort, Colleton, Jasper) (US Travel Association, 2019).

Tourism and recreation revenue generated in beach communities in South Carolina is estimated to range from **$1.52 billion - $3.09 billion per year.**

As a lower bound estimate, data on South Carolina state accommodations tax (A-tax) collections was investigated for the incorporated beach communities listed in SCPRT (2019b). A total of $30.37 million in A-tax revenue was collected from South Carolina's beach communities in 2018 (SCPRT, 2019b). Based on

the 2% A-tax rate, at least $1.52 billion was spent in these beach communities. To obtain an upper bound estimate of how much revenue is generated in beach communities, the average spending per trip for both out-of-state and in-state travelers, the number of trips taken, and the percent of travelers that indicated that they went to the beach is used (SCPRT, 2019c; SCPRT, 2019d) to estimate that up to $3.09 billion may have been spent in beach communities.

This suggests that tourism and recreation revenue generated in beach communities in South Carolina can range from $1.52 billion - $3.09 billion per year.

Coastal Protection Due to Wetlands

Wetlands within beach and barrier island ecosystems provide a buffer against wave energy and storm surge as well as necessary storage area for stormwater runoff, mitigating the impacts of flooding in nearby and adjacent coastal communities.

The economic benefits of coastal protection provided by South Carolina's wetlands contained within the state's beach and barrier island ecosystems are estimated to range from **$329 million - $447 million per year.**

Two different studies were used to estimate the coastal protection benefits provided by wetlands within the state's beach and barrier island ecosystems. One found that wetlands in South Carolina provide coastal protection benefits of $6,246 per hectare per year (Costanza et al. 2008). A more recent study found that wetlands in South Carolina provide coastal protection benefits ranging from $2,024 - $12,456 per hectare per year depending on the county (Sun and Carson, 2020). This research suggests that the economic benefits of coastal protection provided by South Carolina's wetlands contained within the state's beach and barrier island ecosystems can range from $329.39 million - $446.79 million per year.

Carbon Storage

South Carolina's wetlands prevent carbon from being released into the atmosphere through a process known as carbon sequestration, which helps lessen the impacts of climate change. The US Environmental Protection Agency (EPA) estimates that the social cost of carbon is $52 per metric ton per year (Interagency Working Group on Social Cost of Greenhouse Gases, 2016).

An estimated carbon storage economic benefit of **$1.72 million - $5.12 million per year** is provided by wetlands within South Carolina's beach and barrier island ecosystems.

Carbon sequestration rate ranges, as measured on wetlands along the Lower Waccamaw River in South Carolina (Drexler et al. 2013) and on salt marshes in Georgia, (Loomis and Craft, 2010) multiplied by the above social costs yields an estimated carbon storage economic benefit of $1.72 million - $5.12 million per year provided by wetlands within South Carolina's beach and barrier island ecosystems.

It is assumed that the true total estimated economic benefits of carbon storage provided by all coastal habitats associated with beaches and barrier islands (e.g. vegetated sand dunes) will be higher than what is reported above. Thus, this is a conservative estimate.

Water Quality Protection

South Carolina's wetlands serve as natural filters that control the flow of sediment and the flow of nonpoint source pollution. These wetland areas trap and filter sediment that flows downstream from rivers in the upstate, improving nearby and adjacent water quality. By trapping and filtering sediment, wetlands prevent water from getting cloudy, which could disrupt food chains by inhibiting plant growth and the production of microorganisms. By slowing the flow of nonpoint source pollution carried by stormwater runoff, wetlands are able to absorb these pollutants before they are deposited in waterways. Sediment and pollution removal also saves municipalities money on water treatment costs.

Wetlands within South Carolina's beaches and barrier island ecosystems are estimated to provide **$67 million - $83 million per year** in water quality protection benefits.

Adusumilli (2015) estimated the economic benefits of water quality protection services provided by wetlands in South Carolina to be $930 - $1,161 per hectare per year. This suggests that wetlands within South Carolina's beaches and barrier island ecosystems are estimated to provide $66.54 million - $83.08 million per year in water quality protection benefits.

Water Supply Protection

Another function of South Carolina's wetlands is their ability to act like sponges, absorbing and holding water, and releasing it slowly. Water gathers in wetlands from rain and river discharge flowing gradually

Wetlands within South Carolina's beaches and barrier island ecosystems are estimated to provide **$4.21 million - $5.33 million per year** in water supply protection benefits.

into nearby streams and creeks. The water held back by wetlands helps recharge groundwater, helping to maintain our water supplies by increasing the amount of water remaining in aquifers. Adusumilli (2015) estimated the economic benefits of water supply protection services provided by wetlands in South Carolina to be $59 - $74 per hectare per year. This suggests that wetlands within South Carolina's beaches and barrier island ecosystems are estimated to provide $4.21 million - $5.33 million per year in water supply protection benefits.

Sea Turtle Habitat

Sandy beaches near dune systems on South Carolina's coastal shoreline provide critical nesting habitat for sea turtles (mostly loggerhead sea turtles, with some rare sightings of green turtles and Kemp's ridley turtles). These animals are commonly identified with other charismatic megafauna as having societal value. In South Carolina, sea turtles are a popular species and symbol along the coast, found in works of art and serving as fundraiser causes. The South Carolina Aquarium partners with South Carolina Department of Natural Resources (SCDNR) to run the Sea Turtle Care Center, aiding in the conservation of sea turtle species. Rehabilitated sea turtles are also returned to the wild when appropriate, and the South Carolina Aquarium/SCDNR organizes sea turtle release events for the public to attend. All of which provides evidence that these species are valued by coastal communities in the state.

The economic benefits of sea turtle habitat in South Carolina are estimated to range from **$8.80 million - $12.55 million per year.**

Based on a contingent valuation study conducted in North Carolina, and adjusting for income between our two states, households in South Carolina are estimated to be willing to pay $23.45 per household per year to preserve loggerhead sea turtle nesting habitat (Whitehead, 1992; Rhodes and Pan, 2015). Based on the number of occupied households (535,393) in South Carolina's eight coastal counties (US Census, 2018), the upper bound of economic benefits provided by the presence of loggerhead sea turtle habitat in South Carolina is estimated to be $12.55 million per year.

Estimating an economic benefit for rare or endangered species such as sea turtles can also be determined through the civil fines levied against those who disrupt these species, with the understanding that the presence of the species is assumed to be worth at least as much as the fine incurred for taking it. Engeman et al. (2019) used this method to estimate the economic consequences of turtle nest predation carried out by feral hogs from 2010-2017 on North Island in South Carolina. South Carolina statutes (§ 50-15-30; § 50-15-80) specify that the unlawful take of such species specifies is associated with a $1,000 fine. The SCDNR Marine Turtle Conservation Program identified 8,802 sea turtle nests in 2019, a record year since monitoring started in the 1980s (SCDNR, 2020). Based on this estimate of $1,000/nest, the estimate for the lower bound of economic benefits provided by the presence of sea turtle habitat in South Carolina is $8.80 million in 2019.

This suggests that the economic benefits of sea turtle habitat can range from $8.80 million - $12.55 million per year.

Property Values

Healthier and wider beaches increase the values of nearby and adjacent properties in South Carolina (Pompe, 2008; Pompe and Rinehart, 1999; Catma, 2020). In the most recent study, Catma (2020) estimated this "amenity benefit" of beach width and beach proximity, and found that residential properties on Hilton Head Island receive a 0.15-0.19% increase in price per foot of high tide beach width. They also estimated that the price premium associated with residential oceanfront homes to be 61.9%. Based on the data used in Catma (2020), the total economic benefit attributable to having a property on the oceanfront on Hilton Head Island is estimated at over $168.94 million.

The presence of a healthy oceanfront adds an estimated **$169 million** to property values on Hilton Head Island.

This is certainly a conservative estimate for the total statewide property value enhancement services of beaches as it is only focused on one beach community in the state. Each barrier island in South Carolina is unique, with different conditions that contribute to property value, including but not limited to varying beach widths, oceanfront acreage available for development, proximity to other amenities, and demographics. Therefore, this economic benefit estimated for Hilton Head Island cannot be extrapolated to the rest of the state's beachfront.

While wider and healthier beaches increase nearby and adjacent property values, the corollary to this is that unhealthy beaches experiencing erosion can have a "disamenity effect." Developed properties in these types of situations are at higher risk of experiencing negative impacts from climate hazards and can actually exacerbate erosion and habitat loss if built structures are displacing vegetated habitat. Pompe (2008) found that oceanfront properties near a severe erosion area experienced a 17.4% decrease in property value on Dewees Island, Isle of Palms, Sullivan's Island, Folly Beach, Kiawah Island, and Seabrook Island in South Carolina. In some cases, the disamenity of being near erosion combined with incurring more property damages over time may outweigh the economic benefit of living on the oceanfront.

Unhealthy beaches experiencing erosion can have a "disamenity effect." One study found that oceanfront properties near a severe erosion area experienced a 17% decrease in property value.

Other Ecosystem Services

Other ecosystem service benefits provided by beaches and barrier islands include air quality improvement provided by barrier island vegetation, erosion control, additional coastal protection from the presence of healthy dune systems, shorebird habitat, nursery habitat for fish and shellfish, aesthetically pleasing views, and cultural values (Defeo et al., 2009; Everard et al., 2010). Non-market sociocultural values provided by beach and barrier island ecosystems: such as areas for traditional fishing, harvesting, and agriculture practices; and materials for traditional hand-made goods, like sweetgrass baskets, are also important to acknowledge.

Although statewide economic benefits cannot be confidently estimated for these additional ecosystem services at this point in time, it is still important to recognize that beach and barrier island ecosystems provide more ecosystem services to coastal communities than what is discussed and estimated in this document. This suggests that the true level of economic benefits provided by beaches and barrier islands in South Carolina is likely greater than what is reported here, emphasizing the need for more research into estimating these benefits.

Summary

The ecosystem services provided by South Carolina's beaches and barrier islands help sustain coastal communities in the state and enable them to thrive. Healthier natural resources produce more ecosystem services, which highlights an important link between environmental conservation and human well-being. As a way to produce more socially optimal outcomes that maximize social and ecological well-being, non-market ecosystem service values must be proactively taken into account when evaluating policy, land use, and marine planning decisions to better comprehend the true societal costs and benefits of these decisions. This necessitates not only an examination and synthesis of what is currently available, but further investments in these types of studies as well so that additional values specific to the state of South Carolina can be derived.

Lower and upper bound estimates are provided for each ecosystem service for which economic benefits were estimated. It is necessary to use extreme caution when considering the aggregation, or combining, of these benefit estimates, as some were derived through cost-based methods (e.g. storm damage reduction value of wetlands, carbon storage), some were derived through price-based methods (e.g. recreation, upper bound for sea turtle habitat). It also must be noted that these benefits were estimated based on average values reported in past studies. It is likely that not every hectare of coastal habitat is created equal. For instance, not every section of wetland habitat will reduce wave energy in the same way, and some sections may be more valuable than others based on their location and/or their vegetation characteristics. While combining the benefits and determining marginal values for certain sections of coastal habitats have challenges, the evidence presented in this document suggests that beaches and barrier islands in South Carolina are conservatively worth billions of dollars per year in economic benefits. When taking into account other ecosystem service benefits provided by beaches and barrier islands not estimated in this assessment, it is expected that the total economic benefits provided by South Carolina's beach and barrier island ecosystems are larger than what is reported in Table 1.

Table 1: Estimated Economic Benefits of South Carolina's Beaches and Barrier Islands

Ecosystem Service	Estimated Economic Benefits (2019$)		Method Used	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Recreation	$1,518,715,440	$3,088,577,089	Visitor Expenditures	Visitor Expenditures
Wetlands Coastal Protection	$329,390,855	$446,785,088	Damages Avoided	Damages Avoided
Carbon Storage	$1,723,303	$5,115,087	Social Cost of Carbon	Social Cost of Carbon
Water Quality Protection	$66,544,688	$83,082,421	Value Function Transfer	Value Function Transfer
Water Supply Protection	$4,206,967	$5,326,062	Value Function Transfer	Value Function Transfer
Sea Turtle Habitat	$8,802,000	$12,550,494	Fine Amount	Contingent Valuation

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