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

ASSESSMENT NARRATIVE AND METHODOLOGY

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

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THE ECONOMIC BENEFITS OF SOUTH CAROLINA'S BEACHES AND BARRIER ISLANDS

Assessment Narrative and Methodology

Introduction

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 (Defeo et al., 2009; Everard et al., 2010).

Environmental goods and services produced by ecosystem functions can be generalized into the term "ecosystem services." Ecosystem functions refer to the habitat, biological, or system properties or processes of ecosystems, while ecosystem services represent the benefits human populations derive from ecosystem functions (Costanza et al., 1997). These may be direct services like fish and oysters for consumption, or indirect services such as providing protective buffers against storms and flooding. 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. Ecosystem services are typically grouped into four categories: supporting (e.g., soil formation, nutrient cycling), provisioning (e.g., food, water, timber), regulating (e.g. shoreline stabilization, water purification), and cultural (e.g., aesthetic, spiritual, recreational) services (Millennium Ecosystem Assessment, 2005). Coastal communities are fundamentally dependent on the flow of ecosystem services to support economic activity (Barbier, 2017).

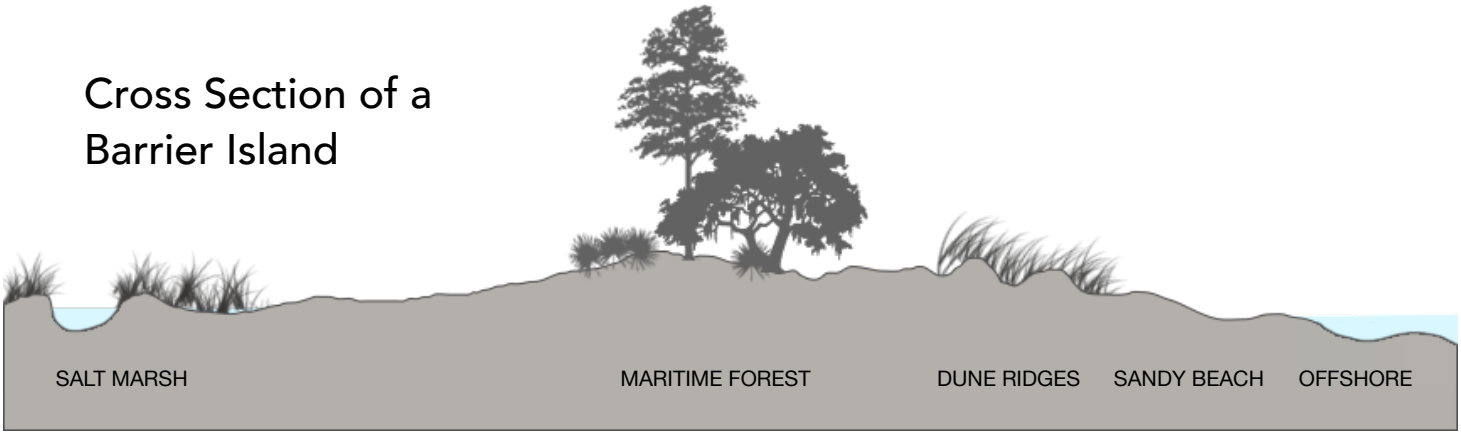


Figure 1: Barrier Island Cross-Section (Source: SC DHEC-OCRM)

While recognizing inherent challenges, several important science and policy scholars have called for more incorporation of ecosystem service values in decision making related to land uses, development, and ecological restoration (Fisher et al., 2009; Daily et al., 2010; de Groot et al., 2010; Villamagna et al., 2013; McKenzie et al., 2014; Congreve and Cross, 2018; Martin et al., 2018). These challenges include defining, classifying, and communicating ecosystem service values (de Groot et al., 2010), the perception that ecosystem services are not as important until after they are lost (Daily et al., 2010), and measuring social benefits after project implementation (Martin et al., 2018), 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 quantified in most cases, which suggests that the incorporation of ecosystem service values in decision making has the potential to produce more socially optimal outcomes (Costanza, 2000).

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 industries like commercial fisheries and tourism. However, monetary benefits for other economically beneficial natural resource assets and ecosystem processes associated with beaches and barrier islands are not typically captured in market transactions. These are referred to as “non-market” benefits, and include things like coastal protection, carbon storage, water quality, and biodiversity (Figure 2). The South Carolina Department of Parks Recreation and Tourism (SCPRT) reports annual data on market-based visitor expenditures (US Travel Association, 2019), and the National Oceanic and Atmospheric Administration (NOAA) reports additional data on market-based expenditures for recreational fishing activities dependent upon beaches such as fishing from shore (NOAA, 2018; NOAA, 2019), and market-based commercial fishing economic benefits (e.g. nutritionally and commercially important fish and shellfish are dependent upon critical nursery habitat provided by barrier island ecosystems) (NOAA, 2018). However, comparable data are unavailable for other non-market benefits provided by beaches and barrier islands. 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.

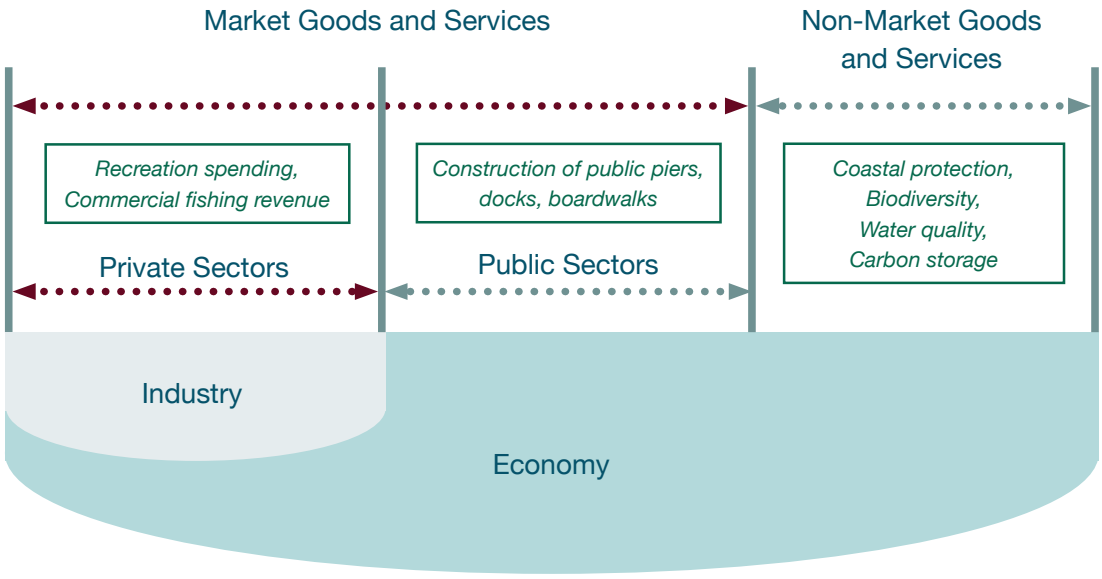


Figure 2: An Economy is Comprised of Market and Non-Market Benefits (Park and Kildow, 2015)

An investigation of existing data and literature 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" (Lyon et al., 2018), and standard best practices for conducting a benefit transfer are followed in this assessment (Johnston et al., 2015). Ecosystem service valuation studies are selected for benefit transfer based on the appropriateness of the estimate(s) for South Carolina. Considerations in transferring values include:

- Methodological merit
- Habitat similarity
- Geographic proximity

Employing this method allows us to utilize an ecosystem service framework 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. As described previously, beach and barrier island ecosystems contain wetlands, maritime forests, sandy beaches, and dunes. Wetlands extend far beyond coastal areas in South Carolina, therefore wetland habitat in South Carolina had to be restricted to beach and barrier island areas in order to estimate ecosystem service benefits for these specific ecosystems. The area of wetlands in the state was calculated based on the US Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) (USFWS, 2018). This wetland area was then restricted to beach and barrier island ecosystems in the following fashion (Figure 3) to approximate economic benefits provided by wetlands within these ecosystems, including all wetlands:

- seaward of the Intracoastal Waterway (ICW) and Waccamaw River in Horry and Georgetown Counties
- seaward of the ICW from Georgetown through Sullivan's Island
- seaward of Schooner Creek adjacent to Morris Island
- within municipal boundaries of Folly Beach, Kiawah Island, and Seabrook Island – in addition to those seaward of Haulover Creek between Kiawah and Seabrook Island
- seaward of Ocella Creek, Store Creek, and St. Pierre Creek through Edisto Island
- on Pine, Otter, and Morgan Islands and those seaward of the ICW on Fenwick Island
- seaward of Harbor River and Station Creek
- seaward of the ICW from Port Royal Sound south to the Georgia border

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[1] within these ecosystems.

[1] Includes NWI categories of 1) estuarine and marine wetlands, 2) freshwater emergent wetlands, and 3) freshwater forested/shrub wetlands

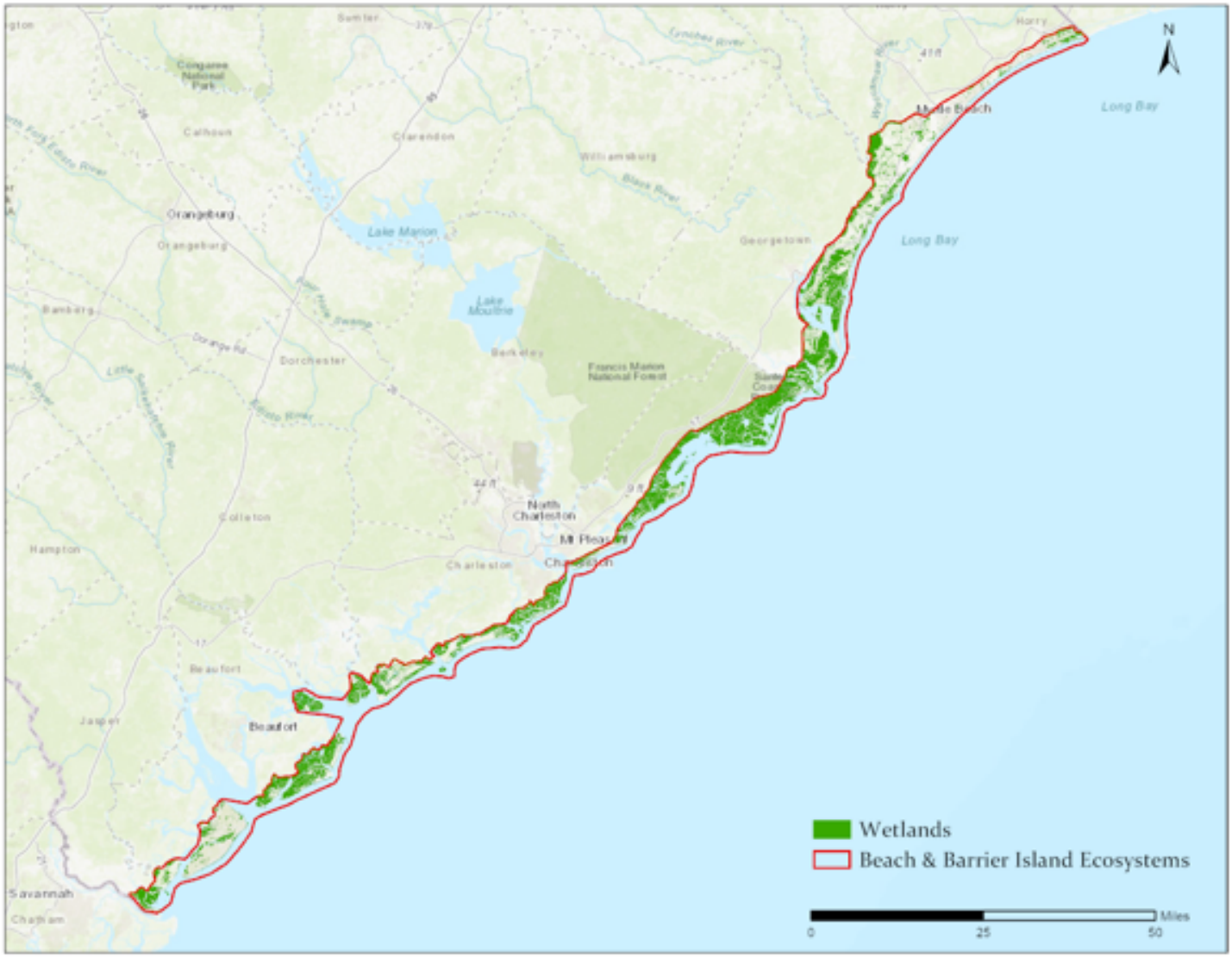


Figure 3: Map of wetlands associated with beach and barrier island ecosystems in South Carolina

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)

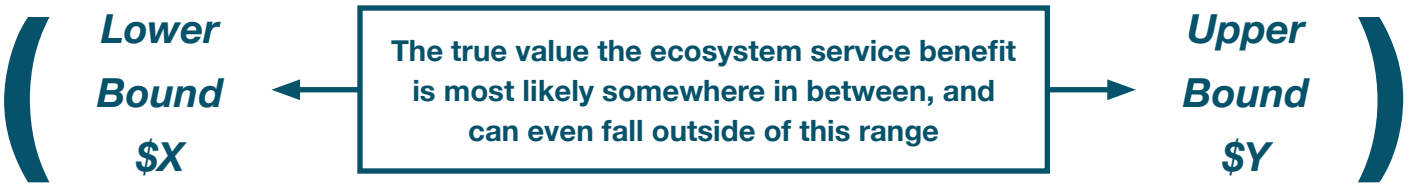
Other ecosystem services provided by beaches and barrier islands not addressed in this assessment, due to a lack of data and information appropriate for South Carolina, include:

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. 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



Recreation

It is understood that the presence of beaches is a major driver of recreation spending in South Carolina's beach communities, and that recreation spending would look significantly different should beaches not exist in these beach communities. Therefore, this assessment will start with the most typically cited economic benefit provided by beaches: recreation space.

The estimation and summarization of visitors traveling to South Carolina from both domestic and international points of origin is generally sourced from marketing research agencies, contracted by SCPRT through the US Travel Association. For 2018, SCPRT's travel data metrics estimated that the annual number of domestic visitors (originating from both within state and out of state) to South Carolina was approximately 33.8 million. These 33.8 million visitors spent approximately 125.1 million visitor-days in the state (SCPRT, 2019a). Statewide tourism expenditures (in state and out of state) 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). These generalized data are not broken down further to shed light on exactly how much money was spent in beach communities. However, a few other data points can be used as a proxy for estimating how much of these expenditures might have been spent in beach communities.

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).[2] A total of $29.8 million in A-tax revenue was collected from those beach communities. When dividing by the A-tax rate of 2%, this suggests a total of $1.49 billion ($1.52 billion in year 2019 dollars) was spent in beach communities to generate this A-tax revenue. The reason this is a lower bound estimate is because there is spending that takes place in beach communities that is not taxed with the A-tax. For example, beach visitors spend money on other items like parking, food, and drinks that are not taxed with the A-tax, as the A-tax is typically associated with hotel and other types of lodging purchases. Since spending on other items like those listed above is not included in A-tax revenue, this estimate based on A-tax revenues can be considered a lower bound estimate for total beach visitor expenditures.

To obtain an upper bound estimate, additional data from SCPRT is utilized. According to SCPRT, out-of-state leisure[3] visitors took 5.1 million trips in South Carolina in 2018, spending an average of $1,141 per trip (SCPRT, 2019c), and in-state leisure visitors took 1.7 million trips, spending an average of $584 per trip (SCPRT, 2019d). Of these leisure travelers, 48% of out-of-state and 24% of in-state travelers indicated that they visited the beach. If it is assumed that these beach visitors only spent their money in beach communities, trip-level average spending suggests that out-of-state travelers are estimated to have spent $2,793,168,000[4] on beach-related expenses, and in-state travelers are estimated to have spent

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[2] Hilton Head Island, Folly beach, Isle of Palms, Kiawah Island, Seabrook Island, Sullivan's Island, Edisto Beach, Pawley's Island, Surfside Beach, Myrtle beach, Atlantic Beach, North Myrtle Beach

[3] Leisure includes entertainment/sightseeing, outdoor recreation, and other pleasure/personal

[4] 5,100,000 * $1,141 * 48%

$238,272,000[5] on beach-related expenses, bringing the upper bound estimate of total annual beach-related recreation spending to $3,031,440,000 ($3.09 billion in year 2019 dollars). The reason this is an upper bound estimate is because visitors indicate the activities that they participate in (e.g. beach, shopping, fine dining) in a "check all that apply" fashion; therefore, while 48% of out-of-state leisure visitors to South Carolina indicated that they went to a beach, it is likely that these particular travelers spent money on other activities as well. However, these upper and lower bound estimates do provide a finer-scale assessment of beach-related recreation spending than simply stating that all money spent by visitors in coastal counties can be attributed to beaches.

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.

Two regional studies that estimated the storm damage reduction benefits provided by wetlands in South Carolina are discussed below as upper and lower bound estimates. Costanza et al. (2008) generated a regression model based on reported damage data from each hurricane that hit the US from 1980-2004, reported wind speeds of those hurricanes, spatially explicit data on gross domestic product (GDP), and wetland area; finding that wetlands in South Carolina provide coastal protection benefits on the order of $4,615 per hectare per year ($6,246 in 2019 dollars). When multiplied by the 71,532 hectares of wetlands, an estimate of $446.79 million per year is derived for the upper bound of economic benefits of coastal protection provided by wetlands within South Carolina's beach and barrier island ecosystems.

Sun and Carson (2020) analyzed reported property damages from tropical storms and hurricanes that hit the United States from 1996-2016 to estimate the expected annual economic benefits of the protective effects of coastal wetlands for counties along the US Atlantic and Gulf coasts. The analysis involved an investigation into each county's area of coastal wetlands and the habitat's influence on reported countywide tropical cyclone damages. The study controlled for the probability of a given county being impacted by a tropical cyclone, which side of the center of the storm path the county was on, storm wind speed, geographic extent of storm area, and county housing values. The estimated annual protective benefits of coastal wetlands in South Carolina was found to range from $1,500 - $11,600 per hectare per year depending on the county ($1,598 - $12,356 in year 2019 dollars).

Based on an area of 71,532 hectares of wetlands within South Carolina's beach and barrier island ecosystems, wetlands associated with South Carolina's beaches and barrier islands are estimated to provide a lower bound of $329.39 million per year in coastal protection benefits (Table 1).

This suggests that the economic benefits of coastal protection provided by wetlands within South Carolina's beach and barrier island ecosystems can range from **$329.39 million - $446.79 million per year**.

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[5] 1,700,000 * $584 * 24%

Table 1: Estimated Annual Coastal Protection Benefit Associated with Wetlands within South Carolina's Beach and Barrier Island Ecosystems

County	Area of wetlands (hectares)	Annual Benefit per hectare (Sun and Caron, 2020) (2019$)	Total Annual Protection Benefit – Lower Bound (2019$)	Total Annual Protection Benefit – Upper Bound (2019$)
Beaufort	32,713	$5,326	$70,508,702	$6,246 per hectare per year (Costanza et al., 2008)
Charleston	74,702	$3,835	$115,926,965	
Colleton	6,181	$2,024	$5,062,557	
Georgetown	45,625	$3,622	$66,871,024	
Horry	13,708	$12,356	$68,544,572	
Jasper	3,831	$1,598	$2,477,035	
TOTAL	**71,532**	**–**	**$329,390,855**	**$446,785,088**

Carbon Storage

South Carolina's wetlands prevent carbon from being released into the atmosphere through a process known as carbon sequestration, which has implications for climate change mitigation. Drexler et al. (2013) found the average carbon sequestration rates for freshwater wetlands with moist soils along the Lower Waccamaw River in South Carolina to be 50-200 grams per square meter per year. The same study estimated that tidal freshwater wetlands sequester 100-435 grams of carbon per square meter per year. Currently, there are no published estimates for carbon sequestration rates of salt marshes in South Carolina, however Loomis and Craft (2010) found that brackish marshes in Georgia sequester carbon at a rate of 93 grams per square meter per year, and salt marshes in Georgia sequester carbon at a rate of 40 grams per square meter per year. The US Environmental Protection Agency (EPA) estimates what the social cost of carbon is projected to be from 2015 to 2050 for each five-year interval in constant year 2007 dollars. In 2020, the EPA estimates the social cost of carbon to be $42 per metric ton per year ($52 in year 2019 dollars) (Interagency Working Group on Social Cost of Greenhouse Gases, 2016). In order to obtain lower and upper bound estimates for the economic benefits of carbon sequestration provided by wetlands within beach and barrier island ecosystems, the aforementioned sequestration rates are applied in the following fashion:

- the "moist soil" carbon sequestration rate range provided by Drexel et al. (2013) is applied to the area of freshwater forested/shrub wetlands
- the "tidal" carbon sequestration rate range provided by Drexel et al. (2013) is applied to the area of freshwater emergent wetlands
- the brackish and salt marsh carbon sequestration rate estimates provided by Loomis and Craft (2010) are applied to the area of estuarine and marine wetlands as upper and lower bounds, respectively.

Each of these rates are then converted to metric tons per hectare per year and multiplied by the social cost of carbon to estimate the economic benefits of carbon sequestration provided by South Carolina's

wetlands that are associated with beach and barrier island ecosystems (Table 2). Based on an area of 71,532 hectares, wetlands associated with South Carolina's beaches and barrier island ecosystems are estimated to provide **$1.72 million - $5.12 million per year** in carbon storage benefits. 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 in Table 2. Thus, this is a conservative estimate.

Table 2: Estimated economic benefits of carbon sequestration associated with wetlands within South Carolina's beach and barrier island ecosystems

Wetland Type	Area (ha)	Lower bound carbon Sequestration Rate (MT/ha/yr)	Upper bound carbon Sequestration Rate (MT/ha/yr)	Social Cost of Carbon (2019$)	Economic benefits per year (2019$)
Estuarine and Marine Wetland	54,302	0.40	0.93	$51.80	$1,125,085 - $2,615,822
Freshwater Emergent Wetland	5,869	1.00	4.35		$303,973 - $1,322,282
Freshwater Forested/Shrub Wetland	11,361	0.50	2.00		$294,246 - $1,176,983
TOTAL	**71,532**	**–**	**–**	**–**	**$1,723,303 - $5,115,087**

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. Adusumilli (2015) estimated the economic benefits of water quality protection services provided by wetlands using benefit-function transfer approach based on a meta-analysis of wetland valuation literature, controlling for the distribution of wetlands and socioeconomic characteristics within a given state. For South Carolina, these water quality enhancement economic benefits are estimated at $793 - $991 per hectare per year (Adusumilli, 2015) in year 2010 dollars ($930 - $1,161 in year 2019 dollars). Based on an area of 71,532 hectares of wetlands within South Carolina's beach and barrier island ecosystems, wetlands associated with 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

South Carolina's wetlands function like sponges, absorbing and holding water, and releasing it slowly. Water gathers in wetlands from rains and river discharge, and flows gradually 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 using the same benefit-function transfer approach described in the previous section. For South Carolina, these water supply enhancement economic benefits are estimated at $50 - $64 per hectare per year (Adusumilli, 2015) in year 2010 dollars ($59 - $74 in year 2019 dollars). Based on an area of 71,532 hectares, wetlands associated with 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 and dunes in South Carolina provide critical nesting habitat for sea turtles (mostly loggerhead sea turtles, with some rare sightings of green turtles and Kemp's ridley turtles), animals 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.

A contingent valuation study in North Carolina found that the recreational non-consumptive use value of loggerhead sea turtle nesting habitat was $22.03 per household per year[6] (Whitehead, 1992; Rhodes and Pan, 2015). Adjusting for geography based on median household income in North Carolina ($26,647) and South Carolina ($26,256) at the time of Whitehead (1992)[7], South Carolina households are estimated to be willing to pay $21.71 per household per year for the preservation of loggerhead sea turtle habitat in year 2014 dollars ($23.45 in year 2019 dollars). 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. This method has been used in past studies for valuing an array of rare species, endangered species, and game species (Bodenchuk et al., 2002; Engeman et al., 2002, 2004, 2016, 2019; Shwiff et al., 2007). Particularly, Engeman et al. (2019) used this method to estimate the economic consequences of turtle nest predation

[6] Value reported in year 2014 dollars from Rhodes and Pan (2015)

[7] Derived median household income figures from 1990 US Decennial Census

carried out by feral hogs from 2010-2017 on North Island in South Carolina. Rare and endangered species are almost universally protected with penalties established in legislation, and the South Carolina statutes (§ 50-15-30; § 50-15-80) that address fines for the unlawful take of such species specifies that violators must be fined $1,000 for such offenses. Instead of applying this fine on a per-hatchling or per-egg basis, a conservative approach of applying this $1,000 value to the number of sea turtle nests identified on South Carolina beaches is used. 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) conducted a hedonic analysis to estimate beach width's influence on property values on Hilton Head Island in South Carolina, while controlling for other property characteristics like building square footage, lot area, number of bedrooms, number of bathrooms, age of home, garage presence, number of stories, distance to beach, if the property was on the oceanfront, distance to nearest beach access, owner residency, and whether the house was in a gated community. Catma (2020) 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), 26% of the 332 homes used in their analysis were on the oceanfront (n=86). The average sale price of an oceanfront property on Hilton Head Island in the dataset used by Catma (2020) was $2,979,182, indicating that the average per-home price premium for being on the oceanfront is $1,844,114.[8] When multiplied by the number of oceanfront homes in the dataset (86), the total economic benefit attributable to having a property on the oceanfront on Hilton Head Island is estimated at $158,593,775[9] in year 2016 dollars (**over $168.94 million in year 2019 dollars**).

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

[8] 61.9% * $2,979,182

[9] $1,844,114 * 86

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.

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. 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. 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.

All dollar figures are adjusted to year 2019 dollars in the table below, 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). 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 3: Estimated economic benefits of South Carolina 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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