

AN ASSESSMENT OF LEGAL FRAMEWORKS FOR SEA TURTLE
CONSERVATION IN THE SOUTHEASTERN UNITED STATES

by

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ABSTRACT

Despite the existence of various legal protections, nesting sea turtles continue to face a myriad of anthropogenic pressures. The Southeastern United States hosts vital nesting grounds for five of the world's seven species of sea turtle – all of which are listed as either threatened or endangered under the Endangered Species Act. This research characterizes the current legal frameworks and regulatory systems that have been installed for the conservation and recovery of federally protected sea turtles at the local government (county and municipal) level within four states in the southeastern U.S. – North Carolina, South Carolina, Georgia, and Florida. The study involved a thorough analysis of federal, state, and local government legislation and conservation efforts. Information garnered from this analysis was supplemented with results from a survey that was sent to elected officials and other relevant stakeholders operating within jurisdictions where sea turtle nesting occurs. The survey provided insight about the perceived successes and shortcomings of various codes and ordinances implemented for the purpose of protecting sea turtles. The survey also gave respondents the opportunity to comment on specific challenges associated with sea turtle conservation efforts and coastal management within their respective jurisdictions. Local sea turtle conservation efforts were assessed by scoring survey responses to produce a “Sea Turtle Conservation Score (STCS),” which was then compared to a variety of parameters derived from historical sea turtle nesting data. Although no significant correlation was found between STCS and historical nesting data, the research did shed light on a variety of factors

contributing to the overall success of sea turtle conservation practices at the local level.

The information provided in this report will serve as an invaluable tool for local governments interested in improving upon existing sea turtle conservation and coastal management efforts within their jurisdiction by providing an opportunity to review common difficulties throughout the region and potential solutions moving forward.

Assessing the state of endangered species conservation and coastal management efforts will become increasingly vital for coastal communities to consider under projected climate-associated impacts.

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CHAPTER 1

INTRODUCTION

“The last word in ignorance is the man who says of an animal or plant: ‘What good is it?’ If biota has built . . . something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.”

– Aldo Leopold, *A Sand County Almanac*

Sea turtles have been roaming the world’s oceans and climbing its beaches to nest for over 100 million years. Persisting through multiple mass extinction events, they serve as a true example of survivorship, and resilience to environmental change. However, with human populations rapidly on the rise, widespread oceanfront development has placed a significant amount of stress on the white sandy beaches that sea turtles rely on to nest (Nelson-Sella and Fuentes, 2019). Despite existing legal protections stemming from multiple government levels, conflict between human activity and nesting sea turtles continues to persist. The coastal shores of the southeastern United States provide an exemplary illustration of this conflict as they contain vital habitat and nesting grounds for six of the world’s seven species of sea turtle. Although sea turtles face a multitude of threats in the marine environment, this research will focus on those occurring during their

nesting phase along the coasts of the southeastern region of the United States, which for the purposes of this study will be defined as North Carolina, South Carolina, Georgia, and Florida. The objective of this research will be to examine and characterize the current legal frameworks and regulatory systems that have been installed for the conservation and recovery of sea turtle populations occurring within this region.

A discussion about relevant federal and state laws will be included; however, the primary focus of the research will be those implemented by county and municipal governments (henceforth defined as “local governments,” unless explicit distinction between the two is needed). This research will work to assess the effectiveness of these frameworks and local sea turtle conservation efforts, as well as provide suggestions for improving imperiled species conservation and recovery programs going forward. To do so, this paper will consider the following questions:

1. Can historical sea turtle nesting data be used as an indicator to measure success of progressive coastal management and endangered species conservation practices?
2. How can sea turtles be utilized as a catalyst for improved coastal management and broader endangered species conservation measures going forward?

Answering these questions required a combination of research techniques. Survey responses from local elected officials were used to identify the existence of ‘progressive’ sea turtle conservation efforts. These responses were then quantified using a point system, to determine if better regulation could be correlated with nesting activity within the study area (more information about this process will be provided in the analysis

section). One of the key considerations in the assessment of local conservation efforts was the presence of sea turtle friendly ordinances. The null hypothesis was that there would be little to no identifiable relationship between local governments with progressive sea turtle conservation programs and healthy sea turtle nesting populations.

This study provides a broader perspective on the current state of sea turtle nesting conservation efforts at the local level, as well as their variation in form and function throughout the southeastern region of the United States. Chapter 1 of this paper discusses the variety of global and regionally-specific anthropogenic factors impacting sea turtle populations. It will also include an overview of the ecology and population status of species nesting within the region, and provide detail about the relevant federal, state and local laws implemented for their protection. Chapter 2 provides detail about the methodology that was used for the research. This will include detail about the survey design and structure, as well as a discussion about the historical sea turtle nesting data and specific parameters that were employed for the research. Chapter 3 provides an analysis of the results and a discussion about what implications they may have for assessing sea turtle conservation and coastal management efforts going forward.

Background: Anthropogenic Threats to Sea Turtles

Currently, all seven of the world's sea turtle species are listed as either threatened or endangered (IUCN Red List). This imperiled status is due to their unique combination of life-history traits combined with increasing threats associated with human activity. Like other long-lived, highly migratory, late maturing organisms (Davenport, 1997), sea turtle populations are particularly susceptible to collapse. Additionally, sea turtles reproduce intermittently (for some species, only every 3 to 4 years). Due to their

expansive ranges and intra-specific biological requirements, threats to sea turtles vary widely between species and across geographic regions. Generally, the primary anthropogenic threats to sea turtles include: Fisheries bycatch, direct-take (such as utilization of eggs, meat, and shells for consumption or trade), coastal development, pollution, and climate change (Wallace et al., 2011). As the overlap between human activity and sea turtles continues to expand, achieving successful conservation and population recovery will be an increasingly difficult task (Cella, 2004). Therefore, examination of current conservation policies and legal frameworks is warranted.

Ocean Threats

Sea turtles are threatened with extinction for several reasons. Generally, these threats change depending on the life stage of a given turtle. As sea turtles spend most of their lives at sea, many of these threats arise in the marine environment. Generally, the most expansive of these threats occur as a result of commercial fishing interests. The primary concern regarding sea turtles in relation to commercial fishing practices is the use of fishing gear that often result in mass amounts of bycatch (the accidental catch of a non-target species). Sea turtles also frequently become entangled in abandoned fishing gear such as passive drift nets or swallow baited hooks on long lines causing them to drown. Although still a major global concern, some progress has been made to reduce sea turtle bycatch and fishery-related mortality through regulation of fishing effort and gear modifications. Probably the most important of these bycatch reduction efforts was the development of the turtle excluder devices (TED), which have been federally mandated to be incorporated on trawling nets since 1987 (Jenkins, 2012). Other gear modifications include the use of C-hooks rather than J-hooks and utilizing bait fish rather

than squid in long-line fisheries. Additional anthropogenic concerns for sea turtles in the marine environment include plastic pollution (both macro and micro), oil spills, and boat strikes (Duncan et al., 2018, Witherington, 2015).

Coastal Threats

Although sea turtles face a multitude of threats at sea, this research will address those impacting the nesting and hatching process along the coasts of the southeastern United States. When an adult female turtle emerges through the surf to nest, she represents a true example of “beating the odds.” Research suggests that only one in every 1000 hatchlings survive to reach sexual maturity upon entering the ocean (Frazer, 1986). However, these estimates of survivorship are made assuming natural conditions, such as predation, disease and exhaustion. Once the influence of anthropogenic impacts are factored in as well, the odds for a nesting female turtle to contribute to the reproductive population undoubtedly become far more slim. Traditionally, hunting was the primary threat to sea turtles on nesting beaches. Although no longer a significant cause for concern in the United States, extractive use of sea turtles is still highly prevalent in many other countries around the world. In Costa Rica (and other Latin American countries), consumptive use of sea turtles is deeply rooted into cultural beliefs. However, there are still several anthropogenic factors that have the potential to negatively impact sea turtle nesting success. In order to better understand these impacts, it is first important to mention the basic characteristics required for successful nesting to take place. As stated by Mortimer et al. (1982), all sea turtle species require a beach (accessible by sea) that is high enough to prevent eggs from tidal or ground water inundation, a substrate that is fine enough to support sufficient gas-diffusion, but also damp enough to prevent the egg

chamber from collapsing. Once a female emerges from the ocean and locates a suitable nesting site, she prepares it for nesting by creating a “body pit”. To do so, she uses her front flippers to create a level surface, clearing away any loose debris and the top layer of sand. She then uses her rear flippers to dig an egg chamber in which she lays her eggs. After egg laying is complete, the nesting turtle fills it in with sand, and camouflages her nest before returning to sea. The nesting process is extremely labor intensive and usually takes between 1 hour and 1 hour and 45 minutes to complete. If at any point during the nesting process the female is disturbed, or sufficient nesting conditions are not met, she may choose to abandon the process and return to sea without laying eggs, performing what is called a “false crawl.” After a false crawl, a female may wait up to a day before making another nesting attempt. However, repeated disturbances can cause a female to select a sub-optimal nesting location, or in drastic circumstances, may cause her to release her clutch at sea.

In the southeastern United States, the primary anthropogenic factors that contribute to decreased nesting success of adult females and survivorship of hatchlings are as follows:

- Disorientation due to artificial lighting, emanating from coastal development and flashlights (Lorne and Salmon, 2007, Witherington and Martin, 2000);
- Egg predation from pets and invasive species (Engeman et al., 2006);
- Inundation of nests caused by sea level rise and storm surge (Murphy, 1985);
- Loss of suitable nesting habitat caused by erosion and sea level rise (Mann, 1997);
- Over-compaction of sand caused by beach nourishment projects, development (Rumbold et al., 2001, Kudo et al., 2003);

- beach driving (Nester, 2006) and foot traffic around nests (Hosier, Kochhar, and Thayer, 1981); and,
- The presence of obstructive objects and barriers on nesting beaches (Triessnig et al., 2012), such as beach chairs, large holes, tire tracks (Aguilera et al., 2019), and hard infrastructure (sea walls, rock revetments and groins), causing entrapment and over exhaustion (Mosier, 1998).

The following section will expand upon these anthropogenic threats and describe how they relate to the various legal frameworks that have been implemented to prevent them.

Coastal Armoring

As sea level rise and erosion continue to threaten highly-valued ocean front property in the southeastern United States, the application of coastal armoring, or hard-infrastructure techniques has become increasingly commonplace. However, these types of applications tend to be highly problematic for nesting sea turtles as they prevent access to the dune systems where they prefer to nest. Coastal armoring is the process of building hard-engineered structures along beaches and dunes with the intent of protecting inland development and property from the effects of coastal erosion, storm surges and sea level rise (Eastman et al., 2016). The most common types of coastal armoring techniques utilized in the southeastern United States come in the form of seawalls, rock revetments, jetties, and groins (Beatley et al., 2009).

Although these strategies are used as a means of protecting valuable oceanfront property, coastal armoring techniques often exacerbate the very issues they intend to resolve by impairing the natural functionality of coastal processes to take place. Thus, giving landowners a false sense of security. For example, the addition of a seawall may

concentrate wave energy that would otherwise be dispersed evenly across a beach, in a downwards direction - thus, accelerating the rate of erosion. A groin – placed perpendicular to the beach – will prevent the natural transport of sand down shore. These side-effects tend to encourage other oceanfront property owners to use armoring techniques as well, creating a “domino-effect” or “armoring-race” (Beatley et al, 2009) along the beach.

Studies show that the application of coastal armoring vastly impairs sea turtle’s ability to successfully nest (Rizkalla and Savage, 2011). By creating a barrier between the beach and the dune-systems, armoring projects such as seawalls often force turtles to nest in areas below the mean high tide line, making nests more susceptible to wave activity and tidal inundation. Hard infrastructure projects also tend to increase sand compaction, making it harder for females to dig an egg chamber and creating a suboptimal incubation environment for the eggs. One study estimated that nearly 93.5% of the sea turtle nesting grounds in Florida are currently exposed to coastal armoring and other forms of coastal modification (Nelson and Fuentes, 2019).

Artificial Lighting

Another pervasive problem associated with coastal development is the addition of artificial light pollution. This is true for both nesting adult females and hatchlings (Witherington and Martin, 2000). After hatching from their eggs (a process called “pipping”), sea turtle hatchlings take between 4-7 days, working collectively, to excavate their way to just beneath the surface of the sand. At this time, they wait until they are queued by a sudden temperature drop – usually occurring at nightfall – to emerge and work their way to the ocean (Witherington et al., 1990). Numerous studies show that the

presence of artificial lighting can have severe ramifications for sea turtles. This is because after hatchlings emerge from the nest, they rely solely on visual cues to guide them into the ocean (Weishampel et al., 2016, Witherington & Martin, 2000). It is common belief that sea turtles developed this response due to the moonlight reflecting on the water. For the millions of years, they persisted in the absence of humans, the landward direction would almost certainly be darker than the ocean – making this a perfectly suitable evolutionary development. However, under current conditions hatchlings are frequently misled in the opposite direction, often leading them onto busy streets, into the pools of private homes and resorts, or trapped in vegetation. For sea turtle hatchlings, time is critical. They have an extremely limited energy budget and are considered a prey item for virtually every coastal predator (including but not limited to, crabs, fire ants, racoons and domestic dogs). Other sources of light that can alter the behavior of nesting females and hatchlings include: campfires, flashlights, and fireworks (Choi & Eckert, 2009).

Obstructive Objects

The presence of large objects, such as beach furniture and recreational equipment (kayaks and sailboats) left on the beaches at night can deter nesting females and create obstacles for hatchlings. Nesting females have been documented being trapped among beach chairs, and eggs can be destroyed by the inadvertent placement of beach umbrellas into unmarked nests (Fujisaki & Lamont, 2016). Large holes on the beach are also capable of trapping nesting females and hatchlings if left unfilled.

Vehicle Use

Driving on beaches is permitted on numerous nesting beaches throughout the southeastern United States (i.e. Cape Hatteras/Cape Lookout National Seashore, NC and

Volusia County, FL). Studies have shown that the activity presents several negative impacts to nesting females and hatchling sea turtles. For example, tire tracks left in the sand have been shown to impair hatchlings from reaching the ocean (Lamont et al., 2002). Another associated issue is the compaction of sand caused by driving directly over a nest (Mann, 1977 & Kudo et al., 2003). Nester (2006) showed that beach driving was positively correlated with the number of false crawls (failed nesting attempts) and caused a decrease in hatchling survival. For obvious reasons, these risks are heightened when the activity is permitted at night when nesting females and hatchlings are more likely to be traversing the beaches.

Mechanical beach cleaning presents many of the same issues for nests and hatchling success. Also called “raking,” mechanical beach cleaning refers to the use of large machinery to remove unsightly trash or debris (such as macro algae) that is deposited onto the beach or is left behind by visitors. Mechanical beach cleaning is often performed using a tractor that hauls a drag bar or rear-mounted blade to collect or burrow loose debris, before smoothing out the surface (Earney, 2017). This process has the potential to interfere with sea turtle nesting either through the excavation of existing nests or the over compaction of sand. Additionally, beach cleaning operations that are performed in the early morning may cover up the tracks left behind by nesting females, making it more difficult for beach surveyors to locate nests and record data on nesting attempts (Earney, 2017).

Climate Change

All sea turtles are threatened by climate change. Climate change-associated effects impact them in several ways. For nesting turtles, the most prominent of these

impacts are sea level rise, increases in the frequency and intensity of coastal storms, and increased sand temperatures (Esteban et al., 2018). Sea level rise and storm surge will exacerbate preexisting issues surrounding coastal erosion, resulting in the loss of critical nesting habitat. Elevated sand temperatures have already been shown to skew the sex-ratios of hatchlings and reducing overall hatching success. Further detail regarding these impacts and how they relate to conservation efforts will be provided in the follow section.

Sea Turtles of the Southeastern United States

The southeastern region of the United States hosts most of all sea turtle nesting activity in the country (Dodd, 1988). Of the seven species of sea turtles worldwide, five of them rely on this region to nest. These species that most commonly nest in this region include the Loggerhead (*Caretta caretta*), the Green Turtle (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricate*) and Kemp's Ridley (*Lepidochelys kempi*). Over 90 percent of all sea turtle nesting in the region occurs in Florida, including the largest aggregation of Loggerhead nesting in the Western hemisphere and the largest Green turtle nesting aggregation in the United States (Weishampel, Cheng, & Weishampel, 2016). It is also the only continental state where Leatherbacks regularly come to nest (FWC, 2015). Hawksbills and Kemp's Ridley's also nest in Florida but in relatively minimal amounts and in sporadic fashion.

Although the vast majority of sea turtle nesting in the southeastern United States occurs in Florida, the three northerly states (North Carolina, South Carolina, and Georgia) contain significant numbers of nesting activity as well. Given their widespread distributions, each species of sea turtle can be broken down into several distinct population segments (DPS), meaning they are genetically unique enough to be treated as

a functionally separate species. For conservation purposes, each species is spatially organized into “Regional Management Units,” or RMU’s (Montero et al., 2018). Similar to DPS’s, RMU’s are tailored based on a number of biogeographic factors such as genetic stock, the unique ecological role played by each species, nesting distribution, and severity of anthropogenic threats (Wallace et al., 2010). Within the Northwest Atlantic RMU, Loggerheads are further classified into one of five Recovery Units. North Carolina, South Carolina and Georgia comprise of the entire Northern Recovery Unit (NRU).

It has also been argued that the more temperate beaches of North Carolina, South Carolina and Georgia are equally critical for recovery of the species (Hawkes et al., 2007). This is largely due to the relatively cooler sand temperatures found in these states. Sea turtles have temperature-dependent sex determination, meaning that the sex of a turtle is determined by the temperature of the sand surrounding the nest during incubation. Protecting the more northerly nesting habitats may be vital for the viability of the population’s recovery as it will provide larger opportunity for genetic diversity and maintaining a balanced sex ratio, adding more males to the population (Standora and Spotila, 1985). The importance of these northerly nesting sites will continue to increase under projected scenarios of warming global temperatures and sea level rise (Center for Biological Diversity). A complete list of average clutch counts and incubation times for individual species nesting in the southeastern United States can be found in Table 1.

Table 1.1 Four of the five species of sea turtle known to nest in the Southeastern United States (Excluding Kemp's Ridley). *Nesting seasons, hatchling seasons, and incubation periods may vary slightly depending on environmental conditions and nesting beach location. (Content from Witherington & Witherington, 2015)

Species	Status	Nesting Interval	Nesting Season*	Hatchling Season*	Clutch Size/Frequency/ Incubation Period	Nesting Preferences
Loggerhead (<i>Caretta caretta</i>)	Threatened (U.S.)/ Endangered (IUCN)	2-4 years	April – September	Late June – Early November	~120 eggs/ 3-6 nests/ 45-65 days	Steeply-sloped, dark beaches with ample dune vegetation. Nest on open beach between most recent high tide line and toe of dune.
Green Turtle (<i>Chelonia mydas</i>)	Endangered (FL) Threatened (NC, SC, GA) Endangered (IUCN)	1-2 years	Late May – September	Late July – Early November	~135 eggs/ 3-6 nests/ 50-70 days	High on beach, close to toe of dune.
Hawksbill (<i>Erermochelys imbricata</i>)	Endangered (U.S.) Critically Endangered (IUCN)	2-4 years	Late April – October	Late June – Late November	~160 eggs/ 3-5 nests/ ~60 days	Narrow beaches with steep grades and dense vegetation. Often lay nests within vegetation.
Leatherback (<i>Dermochelys coriacea</i>)	Endangered (U.S.) Vulnerable (IUCN)	2-3 years	Mid-February – August	Early May – Late September	~80 eggs/ 4-7 nests/ 60-75 days	Steeply sloped beaches with prominent dune structures and vegetation.

CHAPTER 2

LEGAL FRAMEWORKS PROTECTING SEA TURTLES

Attempts to address the threats that coastal development pose to sea turtles are being made at the federal, state, and local levels. At the federal level, the Endangered Species Act (ESA) helps facilitate these initiatives by offering endangered and threatened species legal protection and conservation status. Under the ESA, a species is listed as endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future (16 U.S.C. § 1532 (6)). Each of the six species of sea turtles that occupy the waters of the southeastern region of the United States are listed as either threatened or endangered under the ESA (nmfs.noaa.gov). Each of these species nest within the region except for the Olive Ridley. A visual comparison of the sizes shell structure of these species is shown in Figure 2.1.

1. Loggerhead (*Caretta caretta*) – Threatened
2. Green Turtle (*Chelonia mydas*) – Endangered
3. Leatherback (*Dermochelys coriacea*) – Endangered
4. Hawksbill (*Eretmochelys imbricate*) – Endangered
5. Kemp’s Ridley (*Lepidochelys kempii*) – Endangered
6. Olive Ridley (*Lepidochelys olivacea*) – Threatened

The ESA allows for state governments to develop programs and enact legislation to strengthen endangered species conservation efforts, by entering a “cooperative agreement” with federal agencies. More detail about these cooperative agreements and state-level endangered species conservation policy will be provided in this section as well.

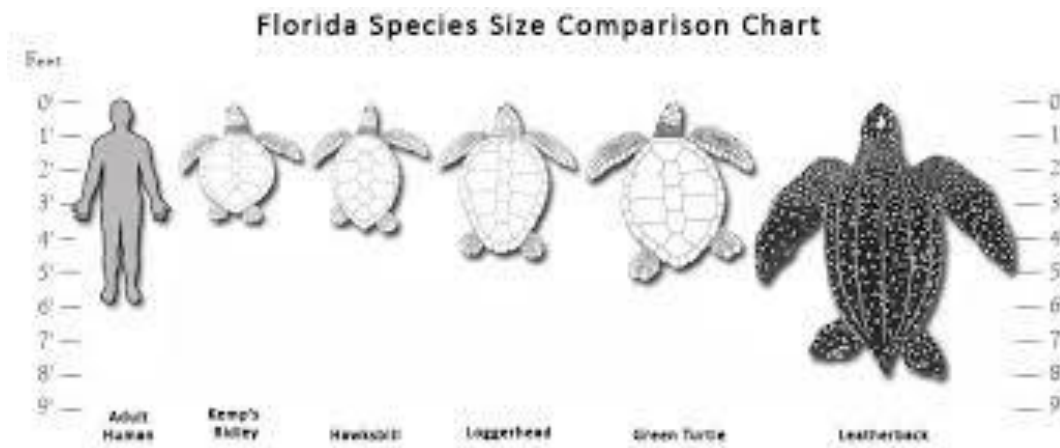


Figure 2.1 Size comparison of sea turtle species occurring in Florida. *Note depicted species also occur in North Carolina, South Carolina, and Georgia but in lesser numbers. (Image source: Florida Atlantic University)

The Endangered Species Act

Legal frameworks for the purpose of conserving sea turtles have been implemented in the U.S. since the 1970's (Arendt, 2016). The first of these frameworks is the federally implemented Endangered Species Act (ESA or “the Act”), enacted in 1973. The ESA offers several protective measures for imperiled species, listed as either “endangered,” or “threatened.” According to the Act, a species is listed as *endangered* if it is in danger of becoming extinct throughout all or a significant portion of its range and *threatened* if it is likely to become endangered in the foreseeable future (16 U.S.C. §

1532 (6)). Although both categories receive similar legal protections, Congress' decision to create the 'threatened' category is important because it allows for protective measures to be implemented prior to the species being on the brink of extinction, thus, providing a greater chance for recovery (Eagle, Salzman, & Thompson, 2017). One of the key strengths of the ESA is that all listing decisions must be made based on sound scientific information, precluding consideration of economic consequences. The ESA is jointly administered by the U.S. Fish and Wildlife Service (USFWS), which has oversight of terrestrial species, and the National Oceanic and Atmospheric Association's (NOAA) National Marine Fisheries Service (NMFS), which is responsible for marine species. In this regard, sea turtles present a unique case as their protection is administered by both, as nesting activity falls under the jurisdiction of the USFWS within the Department of Interior, while the marine phase of their lives is carried out by the NMFS within the Department of Commerce. The USFWS also works to mitigate the impacts of beach armoring and erosion through the USFWS Coastal Program, which offers assistance with habitat conservation design and planning on public and privately-owned lands (fws.gov).

An important distinction to remember when considering the success of legal protections provided by the ESA, is that the fundamental purpose of the Act is not solely to prevent a listed species from going extinct, but to ensure recovery of the population as well (Wolf et al., 2015). To reach these ends, the Act provides numerous legal tools for the protection of listed species. The primary legal tools provided by the ESA for the protection of sea turtles and other listed species, include:

- The designation and protection of critical habitat (Section 4)
- The implementation of a recovery plan (Section 4)

- The provision of funding to state and local governments to carry out conservation actions (Section 6)
- Extensive restrictions on “take” and trade (Section 9)
- Enforcement of violations through citizen suits (Section 11)

The true “teeth” of the legal protections provided by the ESA are contained in Section 9 of the Act, which states that “No person may take, harass, harm, pursue, shoot, wound, kill, trap, capture, or engage in any such conduct – knowingly or unknowingly (16 U.S.C. § 9 1532(19)). As it pertains to sea turtles, “take ” includes engaging in any such act that would negatively impact their present or future well-being (individually or collectively, their habitat, nests, and/or eggs) (SWOT Report, 2016). It is also important to note is that Section 9 broadly defines “persons” to include all private and public entities, making them subject to federal jurisdiction and penalties in the event of a “take” (Rivera, 2015).

According to the ESA, any person who knowingly violates any provision of the Act may be assessed civil penalties of \$25,0000 or criminal penalties of \$100,000 and up to a one-year sentence in prison (16 U.S.C. § 1540). Ultimately, the recovery of listed species largely depends on the proper implementation of the tools provided in the ESA.

As of 2014, the USFWS made an amendment designating approximately 685 miles of critical habitat after adding the Northwest Atlantic Ocean distinct population segment (DPS) of the Loggerhead (*Caretta caretta*) to the ESA in 2011. As shown in Figure 2.2, this newly designated critical habitat spans across six states (North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi), covering roughly 45 percent of the total shoreline in that range, and approximately 84 percent of the total

nesting sites for sea turtles (fws.gov). However, past studies have shown that the largest impediments to the success of the Act have been due to the federal government failing to adequately fund conservation efforts and recovery plans, largely carried out at the state and local government levels.

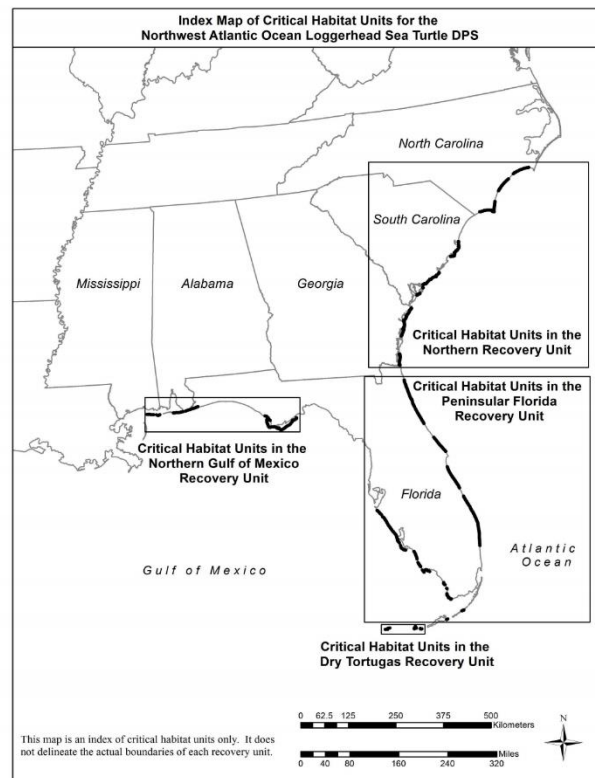


Figure 2.2 Map of Critical Habitat Units for the Northwest Atlantic Loggerhead Sea Turtle Distinct Population Segment (DPS). (Source: U.S. Fish & Wildlife Service)

State Sea Turtle Conservation Laws

Traditionally, much of wildlife conservation and management has been a matter of state control. Currently, each state within the southeastern United States has entered into a “cooperative agreement” with the USFWS. Through section 6 of the ESA, these Cooperative Agreements allow for state governments to devise their own programs for

endangered species conservation and adopt legal frameworks so long as they match or exceed those implemented at the federal level. These agreements often authorize state agencies to issue Incidental Take Permits (ITP's) and Conservation Permits (CP's) to individuals for the purpose of scientific research and education. Section 6 provides financial support for these state programs through the provision of "grant-in-aid" funding.

The ITP provision under Section 10 of the ESA allows non-federal actors to "take" individuals of a protected species, as long as it is done "incidentally" through an activity that would otherwise be considered lawful outside of the legal framework of the ESA (16 U.S.C. § 1539 (a)(1)(B)). ITP's have grown in popularity as a versatile tool for state and private landowners. During the first decade after the ITP amendment was added to the ESA in 1982, only 14 ITP's were issued. By 2010, that number had increased significantly to the approval of 946 by the USFWS alone (Duggan, 2011).

The Florida Marine Turtle Protection Act

Established in 1995, the Florida Marine Turtle Protection Act (MTPA) was passed as part of a Conservation Agreement between the Florida Fish and Wildlife Conservation Commission (FWCC), the Florida Department of Environmental Protection (DEP) and the USFWS. Under the MTPA, the FWCC is responsible for overseeing the conservation of all sea turtle habitat and recovery of their populations. The DEP is responsible for the designation of sea turtle habitat and the adoption of rules to guide local governments to implement sea turtle protective measures, with specific reference to controlling artificial light (FL Statute § 161.163). In many ways, the MTPA further compliments protections provided to sea turtles under the ESA. The MTPA essentially adopts the ESA's definition of "take" specifying it in relation to sea turtles, stating that

“significant habitat modification or degradation that actually kills or injures marine turtles by significantly impairing their essential behavioral patterns, such as breeding, feeding, or sheltering (FL Statute § 379.2431(1)(c)(2)).” The MTPA gives the FWCC the power to enforce regulations and makes violations of take punishable by a third-degree felony. It also grants authorization to the FWCC to issue various permits for activities involving “interactions or research with marine turtles, their nests, eggs, hatchlings, or parts” (FL Statute. § 379.2431(1)).

Although the MTPA provides additional protections for sea turtles, some have argued that the Cooperative Agreement has opened the door for several activities that would otherwise violate prohibitions set forth by the ESA. One example of this is through the issuance of permits for coastal construction projects on or near nesting beaches during the nesting season. Some have argued that interpretations of “take” under the MTPA too relaxed and that state enforcement agencies are far too passive in their approach to prevent potential violations (Rivera, 2015). Thus, making them vicariously liable for the prohibited actions occurring within the state.

South Carolina Beachfront Management Act

Established in 1988, the South Carolina Beachfront Management Act (SCBMA), was created as an additional component to the state’s Coastal Zone Management Program. The SCBMA includes several provisions that directly and indirectly relate to the protection of sea turtles. The intent of the SCBMA is to “protect life, property, and habitat, while preserving beaches for the benefit of future citizens” through preserving the functionality of beach and dune systems to provide a buffer against coastal storms and

erosion (Free, 2005). The law establishes a few major provisions relevant to the conservation of sea turtles, including:

- The establishment of set-back lines along the South Carolina coast;
- Banning the future construction of sea walls;
- Limiting the size of buildings allowed within predicted “erosion zones”;
- The adoption of a retreat policy, moving development away from areas containing sensitive beach habitat;
- Setting guidelines for beach nourishment and dune restoration projects
- Protecting all dune systems located seaward of the established set-back line
- Regulating vehicle traffic on beaches and dune systems

The SCBMA is administered by the South Carolina Department of Health and Environmental Control’s Office of Coastal Resource Management (DHEC – OCRM). The law engages local governments by requiring them to create individualized “beachfront management plans,” which must meet or exceed the minimum standards set by the SCBMA. Local governments are incentivized to create these plans, as doing so allows them to participate in funding programs for coastal restoration projects such as beach nourishment. Although the SCBMA prohibits construction of new sea walls, there are a growing number of instances where oceanfront land owners are attempting to find ways around the law.

Vicarious Liability Theory

The passing of codes and ordinances is often a response to the fact that states, cities, and counties are considered “persons” under the ESA and thus, cannot lawfully

“take” a protected species. Vicarious liability refers to the idea (and legal theory) that state and local governments who fail to prevent takes by private parties can be held liable for the action under Section 9 of the ESA. In other words, the claim of such suits being that the absence of policies or lack of adequate enforcement measures to prevent prohibited actions of “take” from occurring, makes the governing body responsible for the action taking place. One case that exemplifies this concept is *Loggerhead Sea Turtle v. County Council of Volusia County, Florida*.

This case was filed by a citizen suit against Volusia County for the “taking” of endangered and threatened sea turtles caused by vehicle use on county beaches. This was a highly controversial case, as vehicle use on the counties beaches has considerable historical significance in the area, such as stock-car races on Daytona Beach. After six years of litigation, Volusia County was issued an Incidental Take Permit (ITP) by the USFWS, which required them to develop a Habitat Conservation Plan (HCP). The Volusia County HCP includes several mitigation measures for the “unintentional” taking of threatened and endangered sea turtles caused by beach driving. Included in these mitigation measures are the establishment of “conservation zones,” where beach driving is prohibited, the establishment of a sea turtle rehabilitation facility, and conducting dune restoration projects on certain stretches of beach (see Volusia County Habitat Conservation Plan, 2008). The ITP issued to Volusia County allows for beach driving on 15.4 miles of the county’s 51-mile coastline, all of which had been open to vehicular use prior to the citizen suit being filed under the ESA. Volusia County was also held responsible for reimbursing the cost of legal fees incurred by the plaintiffs, which added up to over \$286,000. The high costs associated with fighting vicarious liability cases such

as this could prove to be prohibitively expensive for local governments and is likely to encourage them to implement more stringent regulations to avoid their susceptibility to similar suits in the future (Glen & Douglas, 2001).

Sea Turtle Conservation at the Local Level

Many local governments, due in part to the fear of vicarious liability, have begun instituting their own regulations to protect sea turtle nesting on the beaches within their jurisdiction. This is largely done through the passing of codes and ordinances, aimed to eliminate or at the least control threats posed to nesting turtles.

Due to the fact that nesting habitat stretches across multiple jurisdictional boundaries, there is often considerable variation in the types of codes and ordinances and the degree to which they are implemented and enforced from one locale to the next.

Lighting ordinances have become increasingly prevalent at both the county and municipal levels in Georgia, North Carolina, South Carolina, and Florida. Although most differ slightly, the general intent of lighting ordinances is to reduce the presence of artificial light in order to minimize disorientation of nesting females and sea-finding hatchlings. Under their new Model Lighting Ordinance that can be implemented by local governments and private property owners, Florida has adopted the slogan: “Keep it low, keep it long, keep it shielded.” This refers to the general principals of “sea turtle friendly lighting,” which suggest keeping lights low to the ground, shielded to block the glow from being visible on the beach, and using only long-wavelengths of light (yellow, amber or red in color) as they have shown to be less impactful to sea turtles (Barshel et al., 2014, Sea Turtle Conservancy).

Although lighting ordinances appear to be the most widely implemented form of sea turtle protection measure, local governments can use ordinances to control or reduce a variety of other potentially harmful human activities as well. Most of these come in the form of behavioral restrictions or zoning regulations. Establishing penalties and holding violators accountable through enforcement are key to upholding the effectiveness of any local ordinance.

However, money may influence a local government's decision to abstain from establishing new or enforcing existing ordinances because they fear that doing so may harm beachfront businesses and dissuade tourists from visiting – reducing valuable revenue for the local economy. This is especially true in Florida as implementation of the state's model lighting ordinance is considered “voluntary” – leaving counties and municipalities to decide whether to adopt or enforce them. Many local governments lack the necessary resources to provide enough enforcement or public outreach – rendering many existing ordinances virtually ineffective.

In order to identify all ordinances relevant to sea turtle protection, an exhaustive literature review of county and municipal legislation was conducted. To do this, documented anthropogenic threats to sea turtles were used as key words. Using these search terms, a list was compiled to include the most commonly identified ordinances, regardless of whether they were explicitly cited as being enacted for the sole purpose of protecting sea turtles. Upon completion of this process, it was determined that ordinances falling under the following categories would be used in the study:

- Limit artificial lighting from beachfront property
- Limit public access on beaches at night

- Limit the use of flashlights on beaches, or require the use of a red-light filter
- Limit or prevent the construction of sea walls and other forms of coastal armoring structures
- Restrict what objects can be left on beaches at night
- Prevent destruction of sand dunes
- Restrict vehicle access on beaches
- Prohibit campfires on beaches
- Restrict dog access on beaches
- Limit “special events” (such as concerts, parties) on beaches
- Restrict mechanical beach cleaning operations
- Limit digging large holes on beaches, or require that they be filled in

The following section will detail the research methods used for the study.

Included in this will be the study area, survey purpose and design, and historical sea turtle nesting data along with other parameters that were employed for comparison with survey results.

CHAPTER 3

RESEARCH METHODS

This study explored the relationship between progressive sea turtle conservation measures and healthy sea turtle nesting activity within the southeastern region of the United States. This research consisted of two primary components. The first component of the research was to gain information about the perceived effectiveness and variation of local sea turtle conservation efforts within the region. This was achieved through the distribution of an online survey. The survey was designed to be taken by public officials from local governments within the study area, although responses from other relevant stakeholders within the public sector were considered as well. Public officials were selected as the primary targets for the survey because they were believed to be the most knowledgeable regarding the perceived success of sea turtle conservation efforts among their constituents and the presence of relevant legislation within their respective jurisdictions. Public officials were also decided on as the primary targets due to the availability of their contact information, which was gathered online. Survey results were used to assess the overall effectiveness of sea turtle conservation efforts for each jurisdiction. To identify a relationship between these efforts and sea turtle nesting activity, survey results were used in conjunction with historical sea turtle nesting data. To make the comparison more quantifiable, survey responses were scored using a point

system to produce a “Sea Turtle Conservation Score” (STCS). The results from this survey were then be compared to various sea turtle nesting parameters gathered using publicly available nesting data representative of the coastal jurisdictions from which survey responses were received. Prior to conducting the survey, the study received an Institutional Review Board (IRB) exemption from Human Research Subject regulations.

Survey Purpose

The purpose of the survey was to identify the various characteristics of sea turtle conservation efforts enacted by local governments within the southeastern United States. The survey was designed and distributed via email using the Qualtrics online survey software. The survey consisted of a total of 30 questions, including a combination of open and closed-ended questions. A complete list of the survey text and questions have been included in the Appendix. In summary, the survey was structured to gather information to help answer the following questions:

1. What is the distribution of Sea Turtle Protection Ordinances (STPO’s) being employed for the intent of conserving sea turtles within southeastern United States?
2. Is there an identifiable relationship between the existence of STPO’s and healthy sea turtle nesting populations?
3. What is the perceived effectiveness of STPO’s among surveyed communities?
4. What are the major impediments to local sea turtle conservation efforts within the study area?

Sample Process and Selection Criteria

The desired sample population for the survey were elected officials from localities (counties and municipalities) in which sea turtle nesting occurs, within North Carolina, South Carolina, Georgia and Florida. These localities were identified by reviewing online records of historical sea turtle nesting data available on seaturtles.org (NC, SC, GA) and the Florida Fish & Wildlife Conservation Commission's (FFWCC) Sea Turtle Nesting Atlas. Using this technique, a total of 47 counties and 196 municipalities were identified as having a record of sea turtle nesting activity within the southeastern United States.

Email addresses for public officials were collected by visiting the websites of every county and municipal government identified. Counties and municipalities which either did not provide contact information on their website or utilized a facilitated contact form were not included in the study. Using this method, a total of 46 counties and 189 municipalities were identified within the study area. Of them, contact information was located for 42 counties and 127 municipalities (169 local governments total). Public officials were identified as anyone with one of the following titles, as shown in Table 3.1.

Table 3.1 Job titles used to identify public official survey participants.

Mayor	Council Member
Vice Mayor	Councilman or Councilwoman
Deputy Mayor	Chairman
Mayor Pro-Tempore	Vice Chairman
Commissioner	County/City/Town Manager
Cabinet Member	President

If provided on the government's website, contact information for those with the following job titles were recorded as well:

- Environmental Program Director
- Code Compliance Director/Manager/Officer
- Habitat Conservation Plan Director/Manager
- Zoning or Planning Administrator/Director/Manager

Using this criterion, a total of 876 email addresses were collected for public officials. Once email addresses were collected, surveys were distributed via email through the Qualtrics secure online survey software. Emails contained a standard message explaining the intent of the survey. Participants were notified in the email, as well as at the beginning and end of the survey that participation was voluntary, and that personal contact information would remain confidential (not be shared or utilized for purposes other than the study) and that responses would not be attributed to the individual. Stating, "This survey is for research purposes only. Responses and contact information will remain confidential, reported in aggregate, and not attributed to individuals." Respondents were also provided a link to the survey that they were invited to forward to additional colleagues who would be knowledgeable about the subject matter or interested in taking it as well. Respondents who took the survey via these links were easily identified and able to be separated from the target audience.

Response collection took place over a four-week period. After emails were disseminated, recipients were given two weeks to respond. Two additional reminder

emails were sent out to those who had not responded by the end of each initial two-week period.

Response Screening and Data Validation Process

Several screening questions were included to ensure that responses from the correct audience were received. At the beginning of the survey, participants were prompted to select the sector in which they were employed. If “Public Sector” were selected, they were asked to choose between: county government, municipal government, or neither. If County or Municipal government were selected, respondents were asked to choose their county or municipality from a drop-down list that only included those for the study. If a respondent selected the “not listed” option for their county or municipality, they were brought to the end of the study and their response was excluded from the results. After responses were collected, they were checked for completion percentage. Responses with a completion percentage less than 80% were excluded from analysis. This number was chosen because 6 of the 30 questions (or 20%) were optional open-ended. Using this validation criteria, a total of 59 responses were collected to be included in the study.

Measuring Strength of Sea Turtle Conservation Efforts

Overall effectiveness of sea turtle conservation efforts was determined by applying a point system to the survey responses. The point system considered the total number of sea turtle protection ordinances (STPO’s) present within each surveyed jurisdiction, degree of compliance and enforcement corresponding to each STPO, public education and outreach efforts regarding sea turtle conservation within the community,

sea turtle monitoring efforts, and degree of armoring and ocean-front development. Points were totaled for each response to provide a Sea Turtle Conservation Score (STCS), which was formulated by the researcher. For jurisdictions in which multiple survey responses were received, STCS's were averaged together. While particular factors might play a larger role than others in terms of their ability to positively impact sea turtle nesting activity (such as the presence of certain ordinances, level of compliance, or education and outreach efforts), this can be difficult to determine (Barshel et al., 2014). Thus, points for each question were weighted using the discretion of the researcher. For consistency purposes, point scales assigned to each question were allocated using positive numbers. Responses to open-ended questions were not included in score calculations.

Sea Turtle Nesting Data

The second portion of the study consisted of an analysis of historical sea turtle nesting data. All nesting data included in the research were provided by seaturtle.org for North Carolina, South Carolina, and Georgia and the Florida FWCC's Sea Turtle Nesting Atlas, both publicly available online. Nesting beaches selected for the analysis were limited to those within jurisdictions from which survey responses were received. This allowed for cross-comparison between the survey results and the current state of sea turtle nesting activity within each jurisdiction. The availability of historical nesting data also played a role in determining which nesting sites were included in the study. Due to lack of available historical nesting data, Hawksbill, Leatherback, and Kemp's Ridley sea turtles were excluded from the analysis. Thus, only data collected for Green and Loggerhead Turtles were considered.

Resources for sea turtle nesting data limited which factors could be compared and analyzed, as there is a considerable amount of variation between the parameters that each monitoring project records and reports. False Crawl-to-Nest ratios (FC:N) were only used for analysis in North Carolina, South Carolina, and Georgia, but not for Florida. FC:N were used as an indicator for sea turtle nesting success, as it portrays the ratio between successful nesting attempts and those that were aborted, potentially as a result of anthropogenic interference (Nester, 2006). Sea turtle nesting data for Florida is recorded through the Statewide Nesting Beach Survey (SNBS). Florida's SNBS program is conducted under a cooperative agreement through the USFWS and FFWCC, with the purpose of documenting factors of abundance and distribution of sea turtle nesting (myfwc.com). These data were used to provide the average nest density at various beaches within the study site over a five-year period. Nest Density was used as a parameter to show the average number of sea turtle nesting emergences occurring within a one kilometer stretch of beach. From this mean nest density (MND) was calculated to represent the parameter throughout all nesting beaches included within a surveyed jurisdiction. Census data were used to record population density and per capita income for each surveyed jurisdiction as well. This was done to determine if correlations existed between these parameters and with STCS, MND, and FC:N.

Word clouds were also used to visually display responses from a number of open-ended survey questions. The following section will include a detailed analysis of the results from the aforementioned research techniques.

CHAPTER 4

RESULTS AND ANALYSIS

Respondent Profile & Distribution

Upon conclusion of the survey, a total of 61 responses were collected. The majority of these responses were from Florida (n=32). South Carolina (n=12), garnered the second most responses. North Carolina (n=10) and Georgia (n=4) received the third and fourth most, respectively. This distribution was not surprising as Florida has the greatest number of jurisdictions where sea turtle nesting occurs out of the four states, and Georgia has the least. The distribution of these survey responses can be viewed by State and by sector in Figures 4.1 and 4.2, respectively. A detailed depiction of the geographic distribution of survey participants from each state can be viewed in figures 4.3 – 4.6, below.

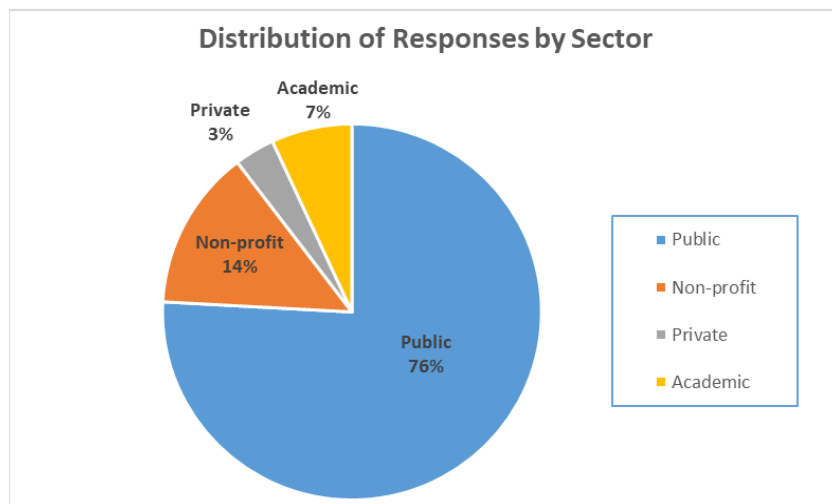


Figure 4.1 Survey response distribution by employment sector

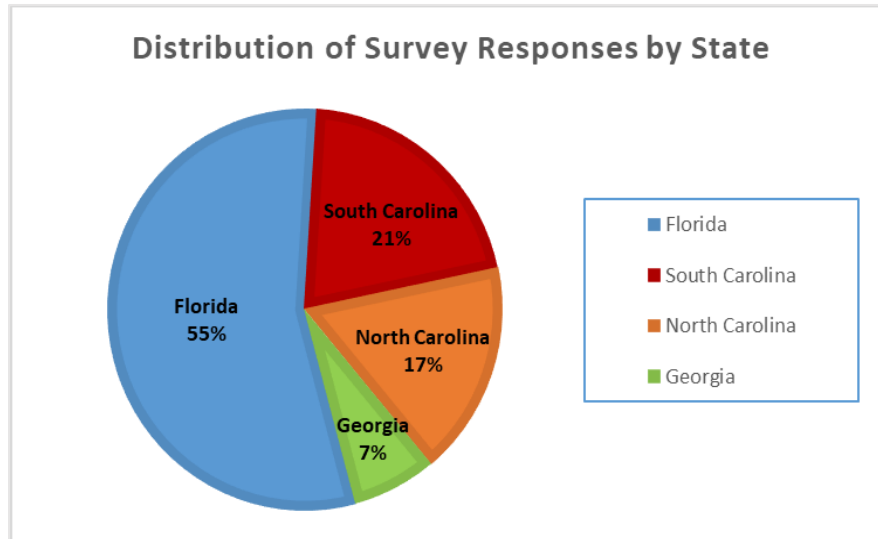


Figure 4.2 Survey response distribution by State

Survey responses for elected officials represented a total of three counties and four municipalities in North Carolina. County government responses in North Carolina were received from Brunswick County, Carteret County and Dare County. At the municipal level, responses were received from Baldhead Island, Sunset Beach, Atlantic Beach, Beaufort, Morhead City, and the town of Nags Head. A geographic representation of these jurisdictions is provided in Figure 4.3.

In South Carolina, responses from elected officials were collected from four counties and eight municipalities. As shown in Figure 4.4, responses from the county government level included: Beaufort County, Charleston County, Colleton County, and Georgetown County. At the municipal level, responses were received from Harbor Island, Hilton Head Island, St. Helena Island, Isle of Palms, Sullivans Island, and Pawleys Island.

North Carolina

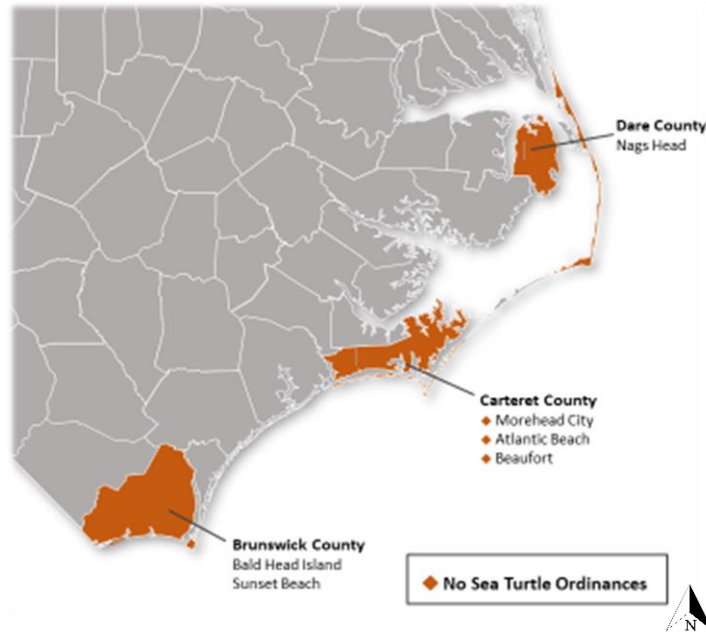


Figure 4.3 Geographic distribution of survey respondents in North Carolina by county and municipality. *Jurisdictions without sea turtle conservation ordinances are marked with a diamond symbol.

South Carolina

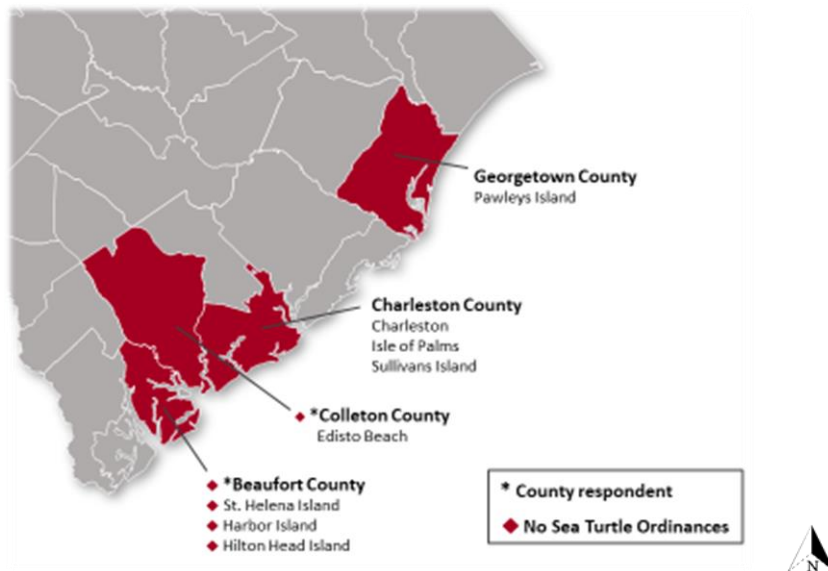


Figure 4.4 Geographic distribution of survey respondents in South Carolina by county and municipality. *Jurisdictions without sea turtle conservation ordinances are marked with a diamond symbol.

In Georgia, a total of three counties and four municipalities were represented by survey results. At the county government level, responses were received from Camden County, Chatham County, and Glynn County. Representation at the municipal government level included The town of Woodbine, Brunswick, Jekyll Island, and Wassaw Island. As shown in Figure 4.5, all surveyed counties in Georgia had at least some form of STPO. At the municipal level, Woodbine and Brunswick were the only two for which an STPO could not be identified in the literature review.

Georgia

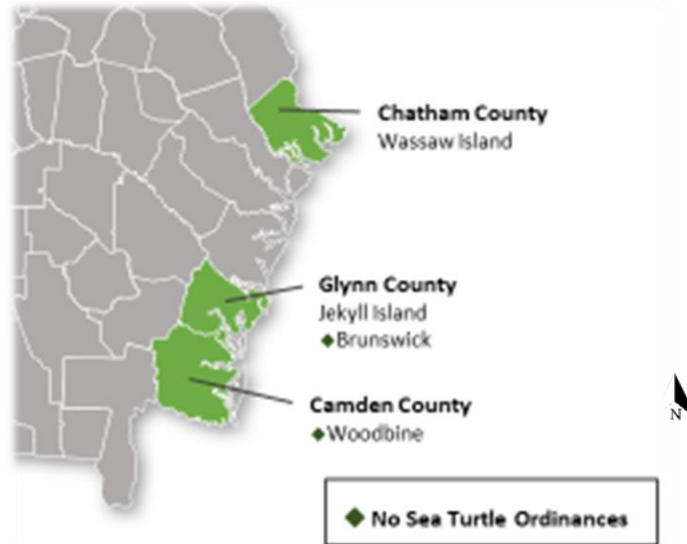


Figure 4.5 Geographic distribution of survey respondents in Georgia by county and municipality. *Jurisdictions without sea turtle conservation ordinances are marked with a diamond symbol.

Florida accounted for the majority of survey responses at 55%. As shown in Figure 4.6, responses accounted for a total of 15 counties and 19 municipalities. Of the surveyed jurisdictions in Florida, Fort Walton Beach represented the only jurisdiction without an STPO. However, Okaloosa County has recently amended the county code of

ordinances to include a variety of STPO's; including the establishment of a "Sea Turtle Conservation Zone" and additional standards for beachfront lighting within unincorporated areas (Article IV, Ordinance NO 2009-03).

Florida

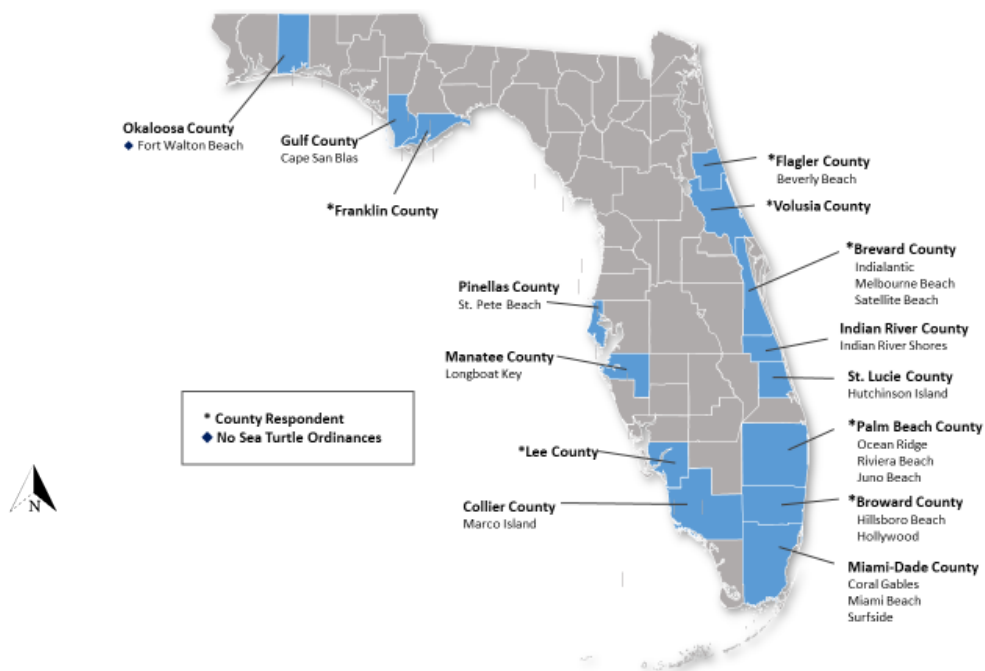


Figure 4.6 Geographic distribution of survey respondents in Florida by county and municipality. Jurisdictions without sea turtle conservation ordinances are marked with a diamond symbol.

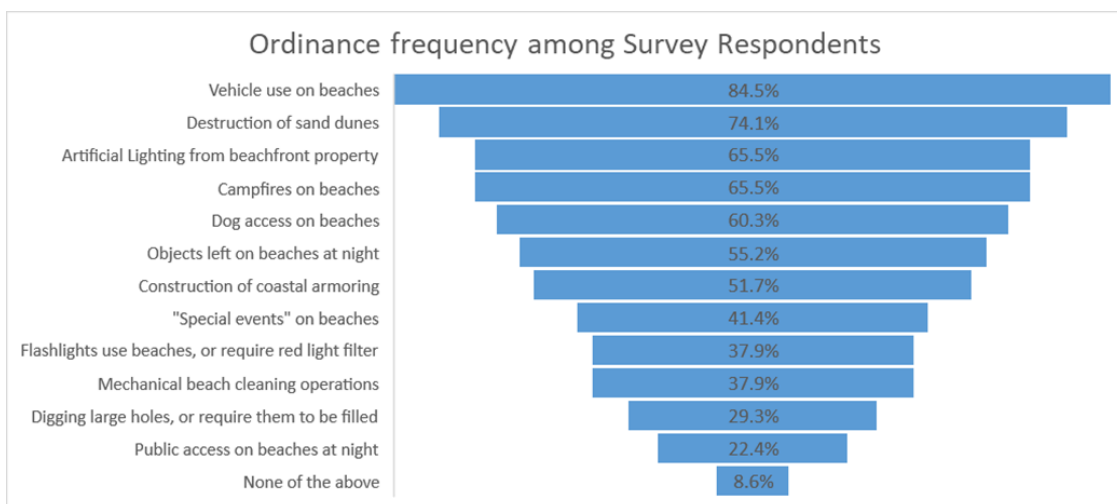


Figure 4.7 Frequency of sea turtle protection ordinances selected by survey respondents.

Figure 4.7 displays the frequency of various STPO's selected by survey participants during the study. It is noteworthy that only 8.6% of survey respondents selected "none of the above"; as it may suggest that the majority of coastal jurisdictions within the southeastern United States possess at least one type of STPO. Additionally, "limitations of public access on beaches at night" was the least commonly cited ordinance. This is not entirely surprising as many local governments are hesitant to infringe upon public access and property rights.

Survey participants were also asked to rate how controversial the implementation of each ordinance was within their jurisdiction. This was done to gain insight on those that may be more readily implemented in other jurisdictions, especially in situations where elected officials might fear backlash from the public. As shown in Figure 4.8, the STPO's most frequently cited as being "very controversial" were those involving restrictions or prohibitions of dog access on beaches. Nearly 96% of respondents identified at least some degree of controversy regarding the implementation of such ordinances as being a controversial topic; meaning they were identified as either slightly or somewhat controversial (in blue), or very controversial (in orange). Interestingly, ordinances that establish limitations on digging large holes garnered a slightly higher "very controversial" response; which may derive from the popularity of the activity for young children. Also noteworthy is that respondents identified limitations on construction of coastal armoring projects as being more controversial than those preventing destruction of sand dunes.

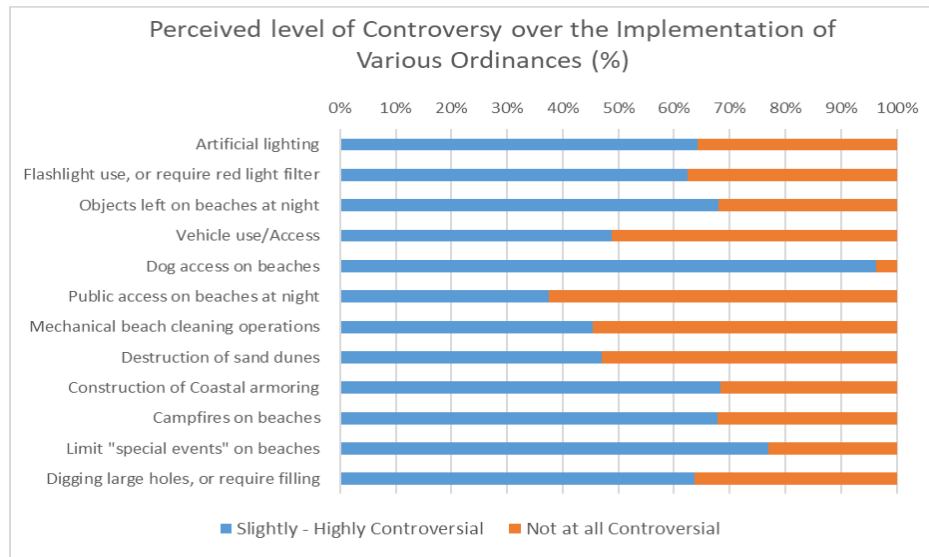


Figure 4.8 Perceived level of controversy pertaining to sea turtle protection ordinances selected by survey respondents. *Responses based on Question #7 (see Appendix A).

The slight disparity between these responses may highlight that although there is public interest in protecting the natural beauty of the beaches, it is still exceeded by the desire to protect private property, regardless of the adverse effects it may have on the dune systems.

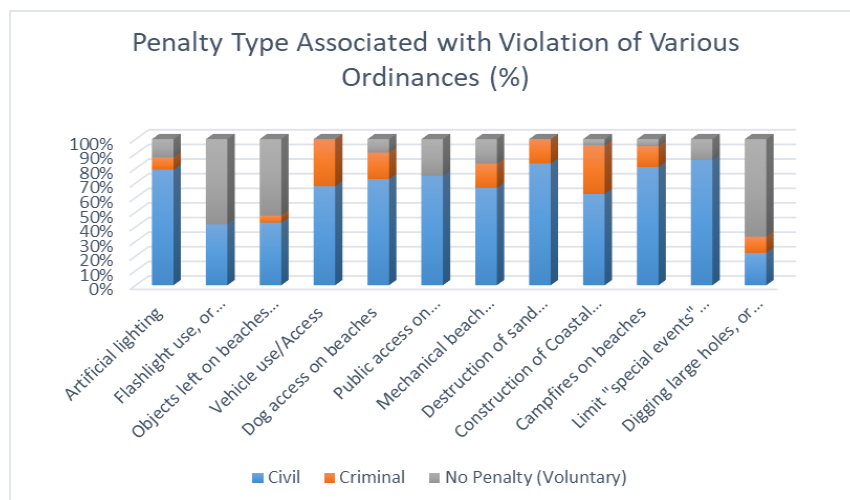


Figure 4.9 Penalty type associated with a violation of selected sea turtle conservation ordinances. *Responses based on Question #8 (see Appendix A).

Survey responses also suggest there are far more civil penalties associated with violations of STPO's. There is also a significant number of ordinances to which compliance is considered "voluntary;" meaning they have no civil or criminal penalty associated with them in the event of a violation. Figure 4.9 demonstrates this by displaying the percentage of ordinances containing civil penalties (blue), criminal penalties (orange), and those that are voluntary (grey). The only two ordinances that were not to some extent voluntary were "vehicle use on nesting beaches" and "Destruction of sand dunes." "Flashlight use (or requiring a red filter on flashlights)," "restrictions of public access," and limiting of "special events" were the only ordinances that did not contain a criminal penalty. Restrictions on "Dog access" and "Digging large holes" on beaches appear to have the lowest perceived level of compliance overall. These are two activities that are very typical on beaches and the relationship they have on nesting sea turtles may not be well understood by the public.

Participants were also asked to rate the level of involvement of various agencies in the role of enforcing STPO's within their respective jurisdictions. As shown in Figure 4.10, the corresponding results for this question suggest that participation by local citizens, local conservation organizations, and local police departments were valued as being the largest contributors to enforcing sea turtle conservation ordinances. Federal and state agencies are perceived to play a much smaller role in this regard.

As shown in Table 4.1, there is a wide variety of techniques being employed to inform the public about the presence of STPO's within the study area. The most frequently cited technique being signage, likely posted at beach access points within

the community. The use of social media and communication through volunteers appear to be prevalently relied on for this purpose as well.

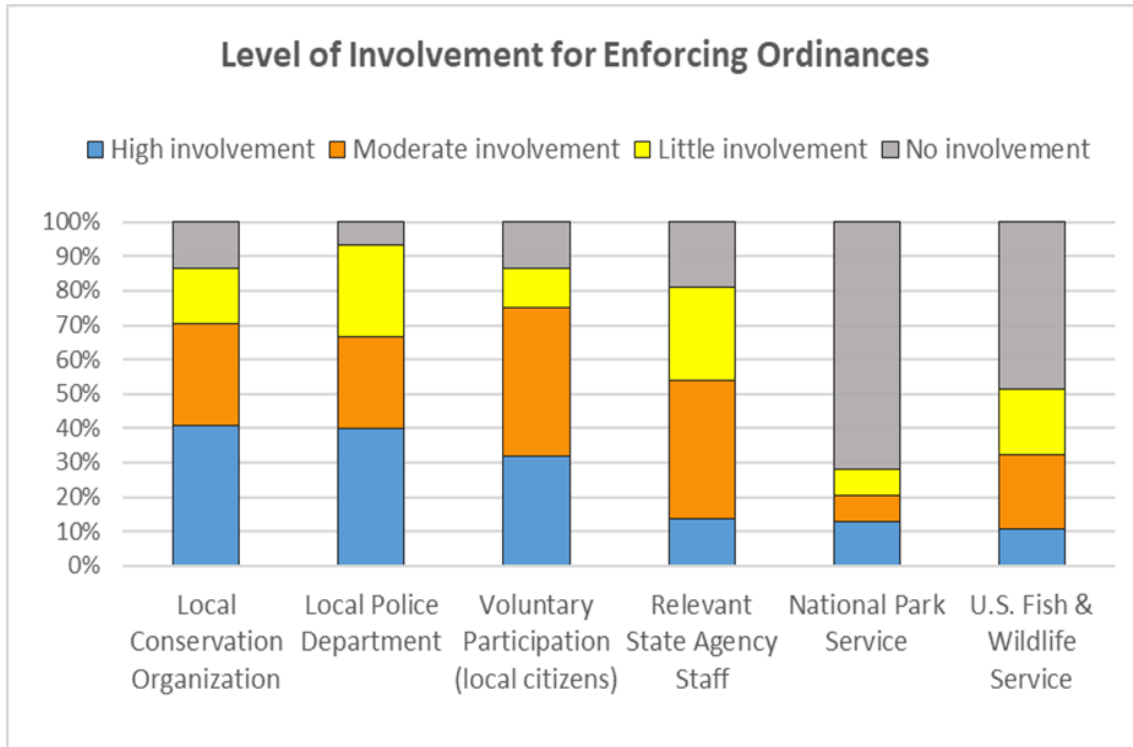


Figure 4.10 Level of involvement for enforcing sea turtle protection ordinances throughout study area.

Table 4.1 Frequency of techniques used to inform the public about sea turtle conservation ordinances among survey respondents. Results based on Question #9 (see Appendix).

How are community members and visitors informed about the presence of these ordinances?							
Signage Posted in Community	Social Media	Communication with Volunteers	Email	Paper Mail	Doorhangers	Other	They are not directly informed
76%	53%	47%	31%	24%	9%	13%	7%



Figure 4.11 Perceived level of compliance for sea turtle protection ordinances administered throughout the study area. *Results based on responses to Question #11 (see Appendix A).

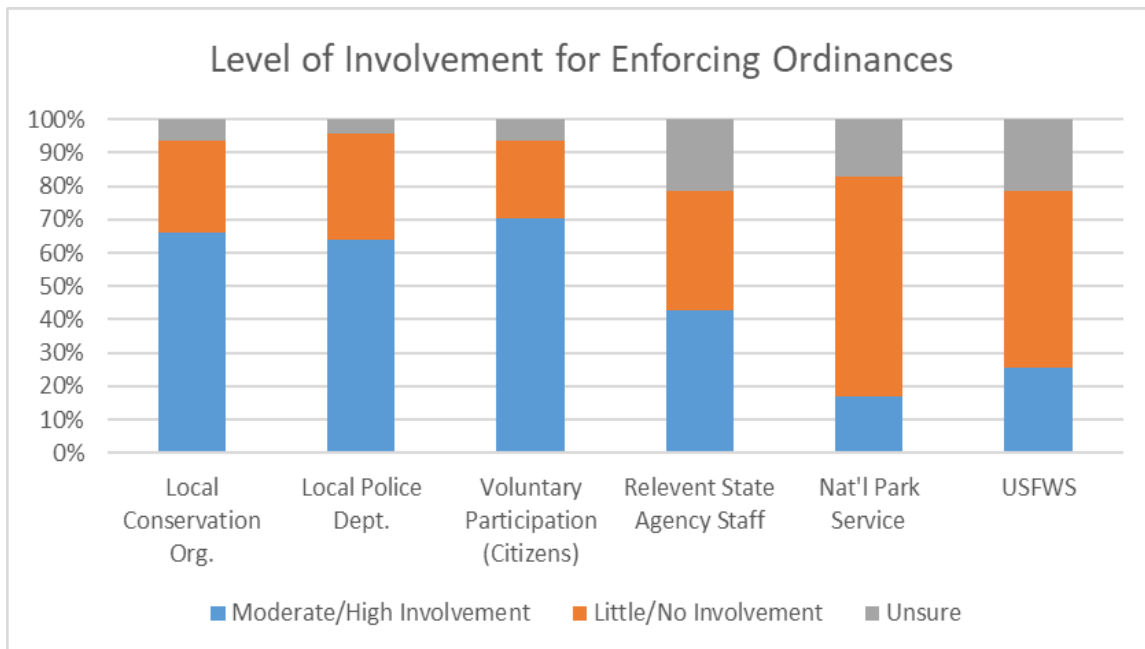


Figure 4.12 Level of involvement for enforcing sea turtle protection ordinances throughout study area.

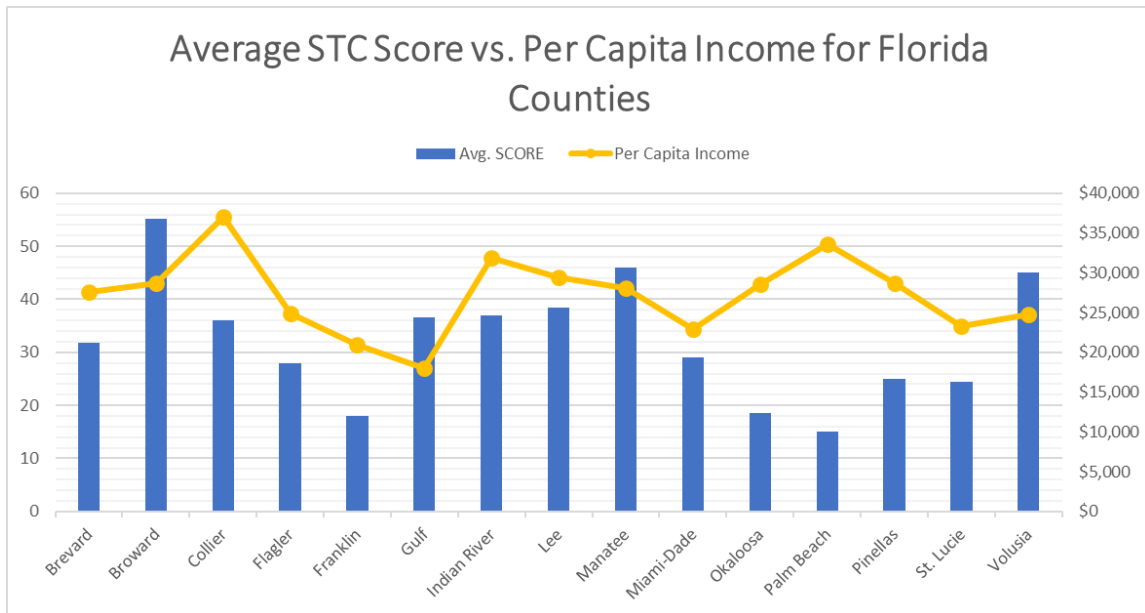


Figure 4.13 Averaged sea turtle conservation score for Florida counties compared to per capita income.

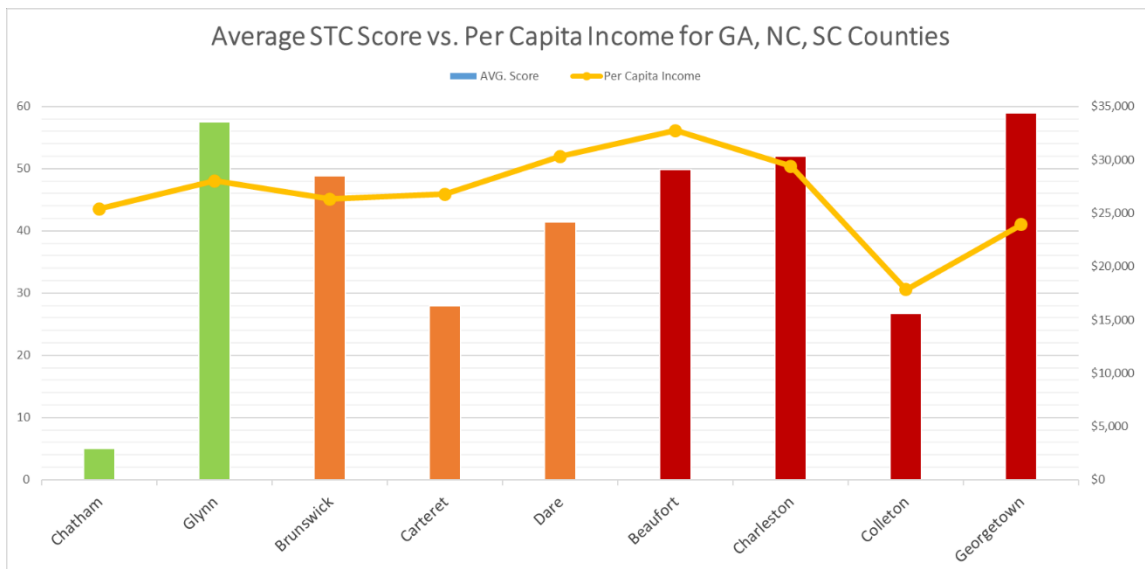


Figure 4.14 Averaged sea turtle conservation score for Georgia (green), North Carolina (orange), and South Carolina (red) counties compared to per capita income.

There appears to be a loose relationship between per capita income and STC Score for Florida counties, and Georgia, North Carolina, and South Carolina counties (as shown in Figures 4.12 and 4.13 above). “Average STC Score” simply refers to the

combined score for all county and municipal responses received for each county. Both states and counties were listed in alphabetical order and represented with the same colors used in Figures 4.3 – 4.6 above.

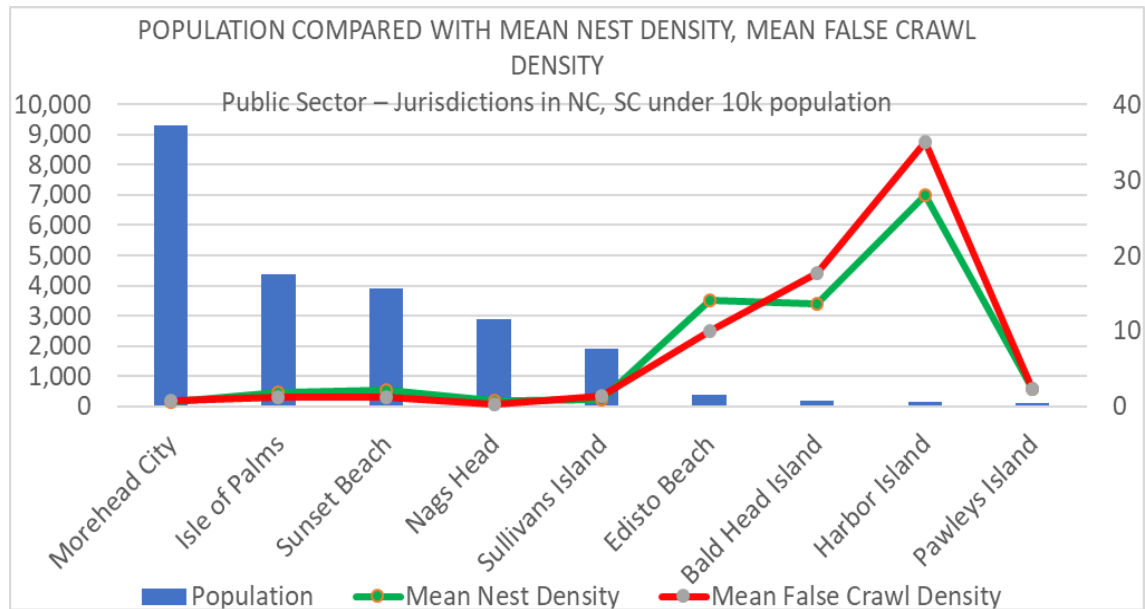


Figure 4.15 Human population compared to Mean Nest Density (MND) and Mean False Crawl Density for surveyed jurisdictions in North Carolina and South Carolina with under 10,000 people.

This chart displays mean nest density (the number of sea turtle nests laid per 1 km) and mean false crawl density (the number of aborted nesting attempts per 1 km) both calculated over an 18-year period; from 2000-2018. When $MFCD > MND$, it may be an indication that nesting conditions are less than optimal. There appears to be an inverse relationship between nest density and false crawl density with human population. This relationship is displayed in Figure 4.14 above, which includes surveyed jurisdictions within North Carolina and South Carolina with populations under 10,000 people (US Census Bureau, 2010). This could be considered an expected result as jurisdictions with higher populations may host lower amounts of sea turtle nesting activity due to the

increased influence of anthropogenic factors. However, it is also possible that the beaches in these jurisdictions are larger (possibly due to nourishment projects), which could contribute to lower nest and false crawl densities. In jurisdictions where Mean False Crawl Density (red) is higher than Mean Nest Density (green), there may be a representation of sub-optimal nesting conditions within the associated jurisdiction. Using this line of thinking would point to Baldhead Island, NC and Harbor Island, SC as areas where improvements to the nesting environment may be needed. Of the sample above, the data would suggest that Edisto Beach, SC currently has the most favorable conditions for sea turtle nesting.

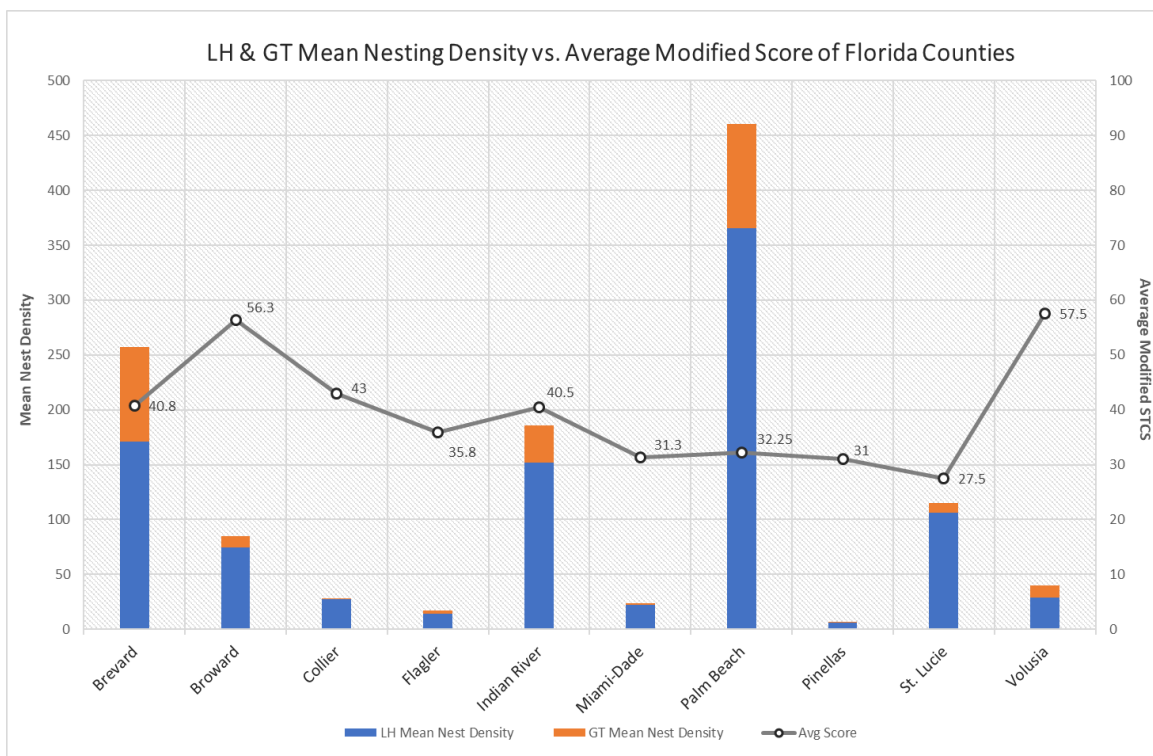


Figure 4.16 Mean Nest Density (MND) for Loggerhead (LH) and Green (GT) sea turtles compared to the averaged “modified sea turtle conservation score” for Florida counties. *Averaged Modified Score was calculated using the actual number of sea turtle conservation ordinances in place of the “perceived number of ordinances” received in survey responses.

Nest density for Loggerhead (LH) and Green Turtles (GT) were compared with STCS for Florida counties. Modified sea turtle conservation score substituted the perceived STPO's from survey responses with the actual number of ordinances identified in each jurisdiction through the literature review. This decision was made to compensate for variations in the type and number of perceived ordinances listed in jurisdictions from which multiple responses were received. Responses for jurisdictions with multiple participants were then averaged together, following suit with the process used to produce the original STCS for North Carolina, South Carolina and Georgia. As shown in Figure 4.14, there does not appear to be any significant correlation between the modified scores and nest densities. However, these results may reveal jurisdictions that have room for improvement on their sea turtle conservation efforts. This is especially true for those that have higher nesting densities and a lower STCS, such as Palm Beach County, FL.

Different from False Crawl to Nest ratio (FC:N) can be used as an indicator for the suitability of nesting conditions on a given beach. As noted earlier, although there are many factors that may be responsible for influencing a false crawl to take place, it is common for them to occur in response to human activity. Figure 4.16 compares FC:N with averaged STCS of surveyed jurisdictions in North Carolina, South Carolina and Georgia. In general, an $FC:N > 1$ represents less favorable nesting conditions (more false crawls occurring per successful nesting attempt), while $FC:N < 1$ represents more favorable nesting conditions.

Figure 4.19 shows a pie chart representing the perceived success of survey respondents towards sea turtle conservation efforts within their respective jurisdictions. These results were derived from responses to Q25 of the survey, which asked: "How

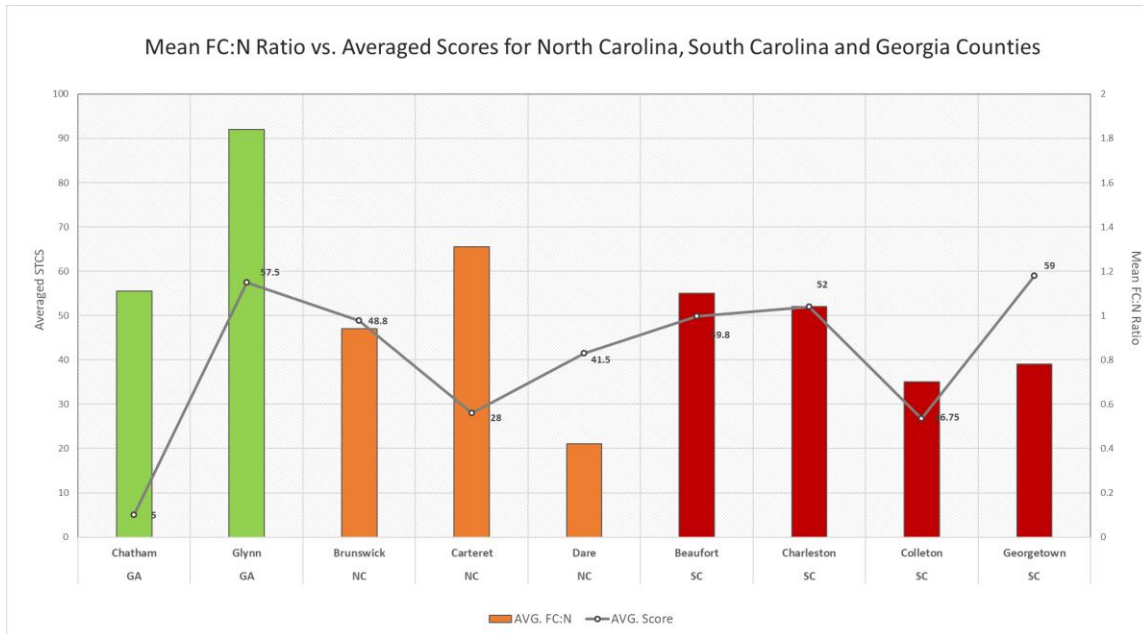


Figure 4.17 Averaged sea turtle conservation score compared to False Crawl to Nesting Ratio (FC:N) for surveyed counties in Georgia (green), North Carolina (orange), and South Carolina (red).

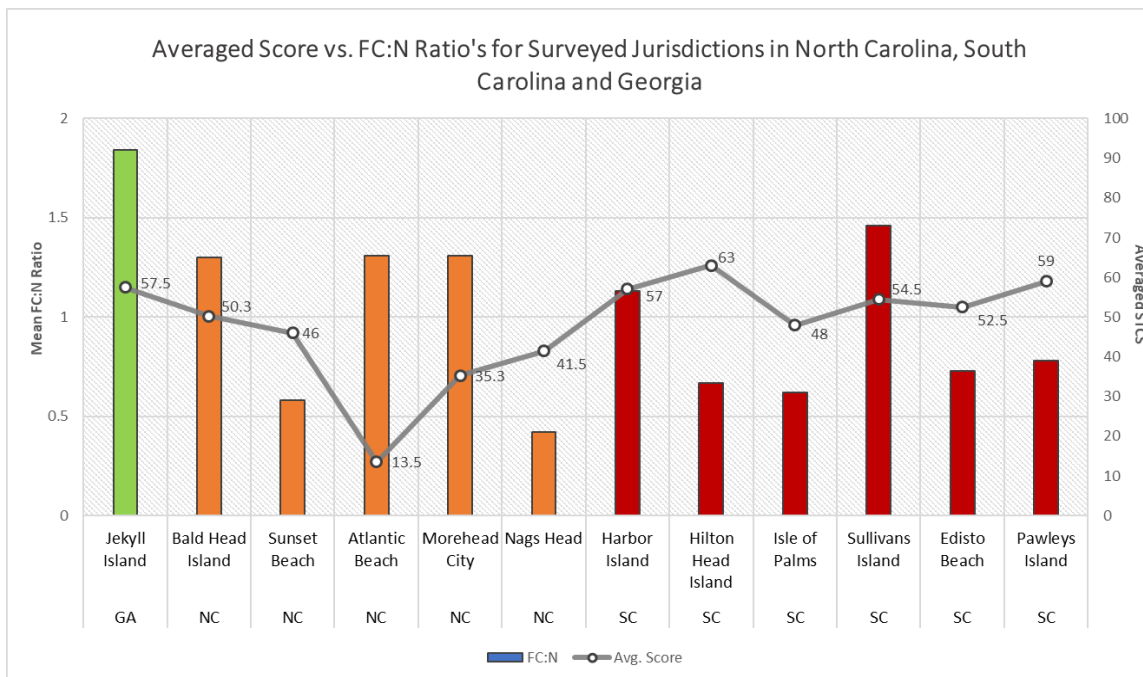


Figure 4.18 Averaged sea turtle conservation score compared to False Crawl to Nesting Ratio (FC:N) for surveyed municipalities in Georgia (green), North Carolina (orange), and South Carolina (red).

would you rate the level of success of sea turtle conservation efforts within your community?” According to the results presented here, 66% of survey respondents viewed the sea turtle conservation efforts within their respective jurisdictions as “highly successful;” 30% viewed them as “somewhat successful;” while a combined 4% of respondents viewed them as either “not very successful, or “not at all successful.”

Q26 of the survey prompted participants to rate the extent to which they agreed with the following statement: “More could be done to improve sea turtle conservation efforts within your community.” As shown in Figure 4.18, 27% strongly agreed; 44% somewhat agreed; 16% somewhat disagreed; and 13% strongly disagreed. It is notable that although the vast majority of respondents (71%), felt that more could be done (either “strongly agreed” or “somewhat agreed”) to improve the current state of sea turtle conservation efforts; an even greater amount (96%) still viewed their sea turtle conservation efforts as a success (either “highly successful” or “somewhat successful”).

"How would you rate the level of success of sea turtle conservation efforts within your community?"

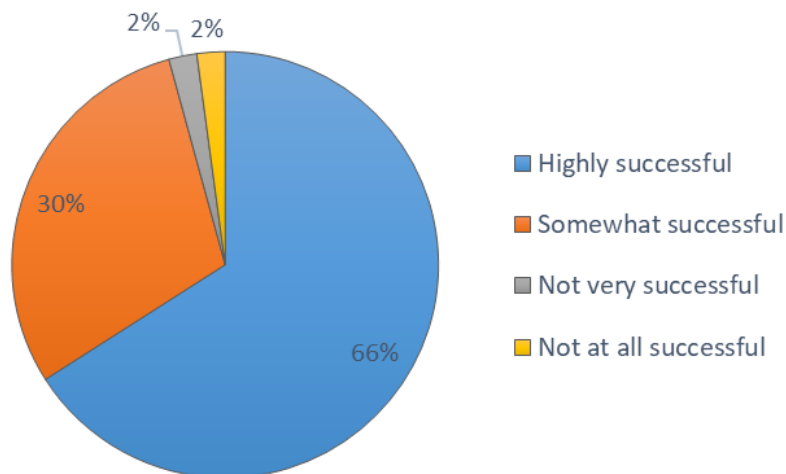


Figure 4.19 Pie chart displaying perceived success of sea turtle conservation efforts within the jurisdictions of surveyed individuals (Q25, see Appendix A).

To what extent do you agree with the following statement?

"More could be done to improve sea turtle conservation efforts within your community."

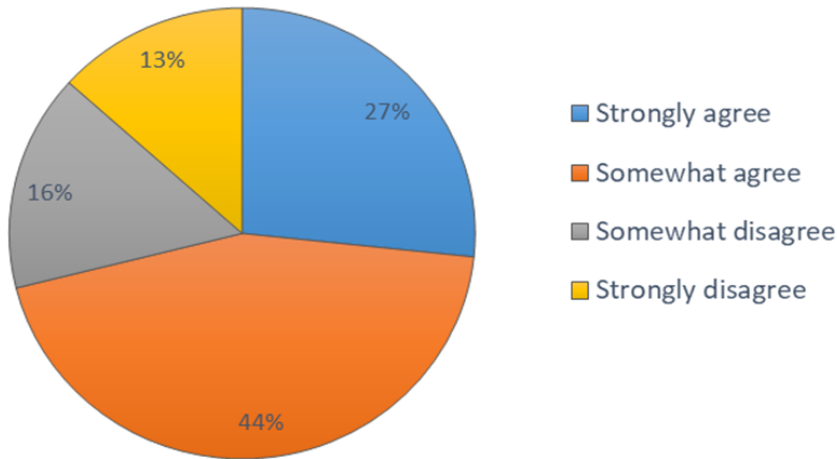


Figure 4.20 Pie chart displaying response distribution of surveyed individuals when asked if “more could be done to improve sea turtle conservation efforts within your community.” (Q26, see Appendix I)

Analysis of Open-Ended Response Questions

Word Clouds were used to visually display content from open-ended survey questions. To do this, responses to the following questions were clustered into one- to three-word phrases.

- “What more could be done to improve the current state of sea turtle conservation within your jurisdiction?” (Question 28)
- “What other major coastal conservation issues does your community struggle with?” (Question 30)

The word clouds for both questions revealed that although there are a wide variety of challenges for both sea turtle conservation and coastal issues in general, there were also considerable similarities among respondents throughout the study area. The word clouds

also revealed a variety of issues that were not included within the scope of this study, but may be worth considering as a focal point for future investigations.

The word cloud for Question 28 “What more could be done to improve the current state of sea turtle conservation within your jurisdiction,” revealed that *Education* and *Enforcement* are two common challenges relating to sea turtle conservation efforts within the study area. *Artificial Lighting* was also singled out as a major challenge. This is interesting as artificial lighting is one of the most pervasive ordinances throughout the study area but reinforces the notion that such measures to reduce it may not be adequately implemented or enforced to be effective.



Figure 4.21 Word Cloud displaying phrases (one to three words each), that appeared most frequently in response to Q28, “What more could be done to improve the current state of sea turtle conservation within your jurisdiction?”

Question 30, “What other major coastal conservation issues does your community struggle with?” was included in the survey to identify any overlap between general coastal conservation issues that could potentially be remedied with applications known to promote successful sea turtle nesting. The word cloud for these responses would indicate that there is a significant amount of overlap between general coastal conservation challenges and those relating to sea turtles such as, *Erosion*, *Renourishment*, *Trash*, *Sea Level Rise*, *Development*, and *Compliance*. The following section will address a few of these challenges currently faced by coastal managers, as they relate to achieving sea turtle conservation as well.



Figure 4.22 Word Cloud displaying phrases (one to three words each), that appeared most frequently in response to Q30, “What other major coastal conservation issues does your community struggle with?”

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE MANAGEMENT

Conclusions

Prior to the research, it was hypothesized that there would be no identifiable correlation between historical sea turtle nesting data and the presence of progressive sea turtle conservation efforts. Although the aim of the study was not to provide statistical validation, the results appear to support this notion. Some of the issues emerging from this finding were due to the long-term nature of sea turtle population assessments along discrepancies between the available nesting data, making cross comparisons difficult over such a large study area. Furthermore, the study was limited by the inherent uncertainties associated with sea turtle population assessments, which is an issue that extends throughout the sea turtle conservation community. This uncertainty largely stems from the fact that data collected on nesting beaches only represent part of the picture. As sea turtles are long lived and highly migratory, their global distribution can cause a significant amount of regional variability in terms of relevant threats and population status.

Additionally, it may have been useful to consider the date that each ordinance was enacted as a parameter for STCS. This could be done in future studies to determine if

their impact on sea turtle nesting success changes over time. Future studies should look to implement more in-depth content analysis as conducted by Barshel et al. (2014), to more precisely assess the regulatory strength of each ordinance. However, such an analysis would have exceeded the time and capacity constraints of this research.

Although there did not appear to be a strong correlation between all aspects of sea turtle conservation at the local level and successful sea turtle nesting, this research did point to the fact that many local governments are taking several positive steps in the right direction. For example, many of the surveyed jurisdictions claim to be actively engaging with their communities through public education and outreach opportunities. The study also revealed the pervasive level of research and data collection that are being conducted on sea turtle nesting beaches within the region. As stated by Leibman (2009), “the root of conservation is education, and only through more research can a community build knowledge that can be relied upon to ensure the security of sea turtle populations long into the future.”

The results presented here along with those of past studies suggest that stricter penalties are needed for existing sea turtle conservation frameworks to be effective. Without the inclusion of such penalties into legal frameworks, the prospect of a potential violation is far less likely to be taken seriously. Additionally, lack of enforcement and community oversight will render existing measures to be inconsequential. In many cases, doing so will require improved coordination from federal and state agencies to support and empower the conservation efforts of local governments. The research also suggests that there is significant public interest in conserving sea turtles throughout the study region. The following suggestion will discuss potential ways to use this interest as a supporting

mechanism for achieving improved coastal management and endangered species conservation going forward. Although no significant correlation was found between STCS and historical nesting data, the research did shed light on a variety of factors contributing to the overall success of sea turtle conservation practices at the local level such as, perceived compliance, presence of enforcement measures, number of agencies involved with enforcement, community interest in sea turtles, engagement with local sea turtle monitoring organizations and access to public outreach and education opportunities. The development of the STCS also provides a framework to be used in future studies. Once perfected, the STCS could be utilized by local governments and sea turtle conservation organizations to rank the suitability of individual beaches for sea turtle nesting on a species-by-species basis. Doing so would likely provide a compelling opportunity to elevate public awareness regarding the condition of individual nesting beaches, increasing motivation to implement improved coastal conservation and management practices going forward.

Recommendations for Future Management

Species loss is a growing concern worldwide. Increasing coastal populations, combined with sea level rise and expanded coastal development make the coastal zone a point of contention between economic growth and endangered species conservation. The implementation of sound conservation strategies has been shown to provide a number of invaluable economic, ecological, and cultural benefits through increased storm surge resilience and eco-tourism to name a few.

As human alterations of the coastal zone intensify, exploring opportunities for progressive coastal management and endangered species conservation will become

increasingly important for local governments. This section will include several recommendations for local governments to consider in the interest of not only promoting sea turtle conservation, but endangered species conservation at-large. Many of the solutions proposed here provide external benefits such as resilience to coastal communities against the associated effects of climate change including sea level rise, increased rates of coastal erosion, and storm surge.

*Land-use Planning for Conservation and Community Resilience:
Policy Options – Construction Setbacks & Planned Retreat*

A preemptive form of retreat (Fish et al., 2008), coastal setback policies refer to establishing a line between future development, coastal infrastructure and the beach system. This allows for natural coastal processes of erosion and accretion to occur without threatening existing infrastructure. Thus, creating a “buffer zone” and eliminating the need for sea walls and other forms of coastal armoring to protect ocean front development. Having this buffer zone also provides added benefits for nesting sea turtles as well. They provide ample opportunities for natural vegetation to stabilize dune structures for nesting, and greatly reduce the intensity of artificial light being emitted from coastal developments (Mycoo and Gobin, 2013). The distance a setback policy should be considered will largely be dependent on the physical characteristics of the coastline adjacent to a given community, as well as the current state of coastal development.

Both short-term and long-term trends of erosion, storm occurrence and projected sea level rise should all be taken into consideration as well. Abuodha and Woodroffe (2010), suggest a “coastal sensitivity index” as a useful framework to assist in calculating the appropriate set back distance for a given community. Ideally, the goals of coastal

managers in response to both short-term and long-term climate-associated impacts should be to keep future developments out of harm's way, while preserving the natural functionality of ecosystems and protecting local economies. If sufficiently implemented and enforced, setback policies and coastal realignment can fulfill these aims through the preservation of sufficient coastal habitat (Fish et al., 2008). Figure 5.1 illustrates two different approaches that can be taken when establishing a setback policy or planned retreat. Figure 5.1 depicts lateral and vertical set-backs in relation to mean sea level (MSL). However, it is important for local or regionally-specific SLR, erosion rates, and impacts of recent storm events to be considered during the policy planning stage as well (Zhu, Linham and Nicholls, 2010). As shown in Figure 5.2, taking both short and long-term trends relating to these factors into consideration is critical when establishing an appropriate distance for a setback policy (Dahm and Gibberd, 2009). This is especially true for the dynamic, sandy beaches of the southeastern United States.

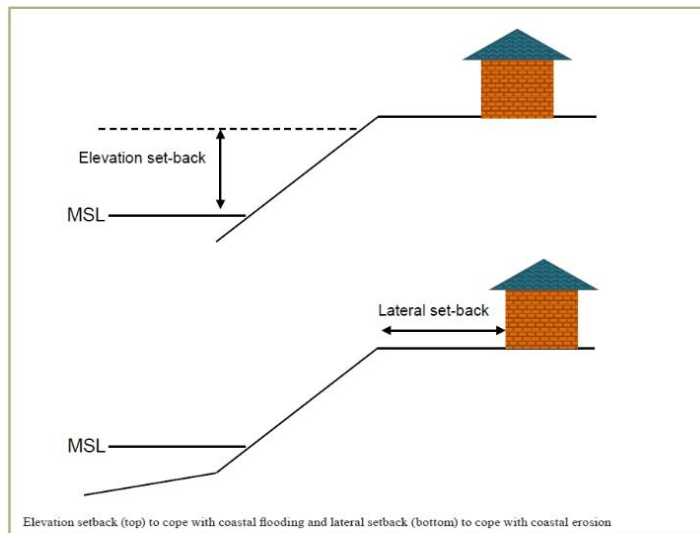


Figure 5.1: Illustration of two different setback approaches (Zhu, Linham and Nicholls, 2010).

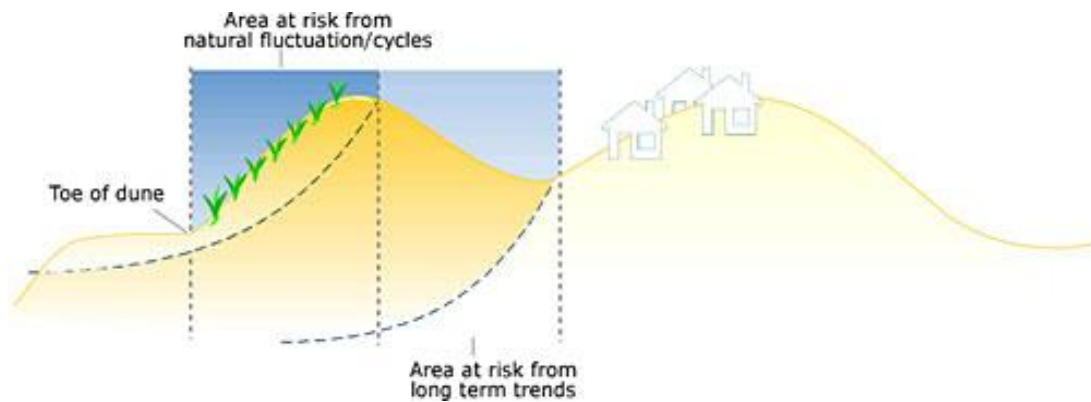


Figure 5.2: Depiction of short vs. long term risks associated with coastal erosion on dynamic sandy beaches (Dahm and Gibberd, 2009).

Land-Acquisition Programs:

Less-than-Fee Coastal Conservation Easements

Traditionally, land conservation has primarily been a matter of state and federal governments through acquiring environmentally sensitive lands or claiming eminent domain. However, the coastal environment and the conservation of sea turtles creates a unique scenario as much of the critical habitat relied upon by nesting sea turtles is considered privately-owned property (Fuentes et al., 2016). Thus, strict regulations placed upon coastal lands may violate the constitution via a “regulatory taking” of private property. Conservation easements are a voluntary agreement between a landowner and the holder of an easement, that restricts certain uses of the property for the purpose of conservation. These easements can be used to protect sea turtle nesting activity in several ways including, through habitat protection, restricting artificial lighting, the presence of coastal armoring, reducing beach erosion and other forms of anthropogenic activity. One of the attractive qualities of conservation easements is that they are far more cost effective than other habitat conservation approaches, such as purchasing land outright and reduces costs associated with managing and monitoring the land. This is because the land

remains in private ownership. Conservation easements provide several financial incentives to property owners. Often these incentives come in the form of federal and state tax benefits. These financial benefits are provided both as relief for the property owner taking on the burden of “perpetuity” and as repayment for the numerous benefits the conserved land may provide the public.

Another quality that makes conservation easements an attractive option for coastal property owners is their versatility. In other words, property owners interested in entering into a conservation easement can be as specific or broad as they would like when defining the intent of the easement. For coastal conservation purposes, and more specifically, for those intended to benefit sea turtles, an easement could include provisions that only apply during sea turtle nesting season. Versatility can also be achieved by dividing the property into separate zones, or parcels (see Florida Model Coastal Conservation Easement). By restricting activities (such as those that may be harmful to sea turtles) in one parcel of property but not others, and only at certain times of the year provides greater autonomy to the property owner, without compromising the conservation values provided to sea turtles (Lomberg et al., 2017).

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APPENDIX A

SEA TURTLE CONSERVATION SURVEY

Q1. Which best describes the sector in which you are employed?

- ☐ Public
- ☐ Private
- ☐ Non-profit
- ☐ Academic
- ☐ Other, please specify _____

Q2. Do you work for a county or a municipality?

- ☐ County
- ☐ Municipality
- ☐ Neither

Q3. Please select your location, below.

**Note: This survey is only intended for those working within certain coastal counties/municipalities in North Carolina, South Carolina, Georgia, and Florida.*

County – Drop down list

Municipality – Drop down list

Q4. Please provide information about your current position below.

Job Title _____
Agency/Department _____
Organization _____

Q5. From the list below, please select the coastal conservation ordinances that are in effect within your community. Select all that apply.

- ☐ Limit artificial lighting from beachfront property and buildings
- ☐ Limit the use of flashlights on beaches, or require use of a red light filter
- ☐ Restrict what objects can be left on beaches at night
- ☐ Restrict vehicle access on beaches
- ☐ Restrict dog access on beaches
- ☐ Limit public access on beaches at night
- ☐ Restrict mechanical beach cleaning operations
- ☐ Limit the construction of sea walls and/or other forms of coastal armoring
- ☐ Prevent destruction of sand dunes
- ☐ Prohibit campfires on beaches
- ☐ Limit "special events" on beaches
- ☐ Limit digging large holes
- ☒ None of the above

Q6. Please identify when the following ordinances are in effect in your community.

	Seasonally	Year-round	Unsure
Limit artificial lighting from beachfront property and buildings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the use of flashlights on beaches, or require use of a red light filter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict what objects can be left on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict vehicle access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict dog access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit public access on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict mechanical beach cleaning operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the construction of sea walls and/or other forms of coastal armoring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prevent destruction of sand dunes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prohibit campfires on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit "special events" on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit digging large holes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/> None of the above	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q7. To what extent was the implementation of these ordinances a controversial topic within your community?

	No penalty (voluntary)	Civil Penalty	Criminal penalty	Not sure
Limit artificial lighting from beachfront property and buildings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the use of flashlights on beaches, or require use of a red light filter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict what objects can be left on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict vehicle access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict dog access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit public access on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict mechanical beach cleaning operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the construction of sea walls and/or other forms of coastal armoring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prevent destruction of sand dunes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prohibit campfires on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit "special events" on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit digging large holes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/> None of the above	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8.Of the ordinances in place within your community, which of the following establish civil or criminal penalties in the event of a violation?

	No penalty (voluntary)	Civil Penalty	Criminal penalty	Not sure
Limit artificial lighting from beachfront property and buildings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the use of flashlights on beaches, or require use of a red light filter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict what objects can be left on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict vehicle access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict dog access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit public access on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict mechanical beach cleaning operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the construction of sea walls and/or other forms of coastal armoring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prevent destruction of sand dunes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prohibit campfires on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit "special events" on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit digging large holes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="checkbox"/> None of the above	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q9. Below is a list of enforcement individuals and organizations.

Please rate each in terms of the involvement they have in enforcing these ordinances within your jurisdiction.

	No involvement	Little involvement	Unsure	Moderate involvement	High involvement
Local police department	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Voluntary participation by local citizens	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring by local conservation organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Staff from relevant state agency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
National Park Service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
U.S. Fish & Wildlife Service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q10. What other entities are typically involved with enforcing these ordinances?

Q11. How would you rate the overall level of compliance with these ordinances within your community?

	Poor	Below average	Average	Above average	Excellent	Unsure
Limit artificial lighting from beachfront property and buildings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the use of flashlights on beaches, or require use of a red light filter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict what objects can be left on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict vehicle access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict dog access on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit public access on beaches at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrict mechanical beach cleaning operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit the construction of sea walls and/or other forms of coastal armoring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prevent destruction of sand dunes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prohibit campfires on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit "special events" on beaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limit digging large holes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
None of the above	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q12. How are community members and visitors informed about the presence of these ordinances? Please select all that apply.

- ☐ Social media
- ☐ Email
- ☐ Paper mail
- ☐ Signage posted within community and around beach access points
- ☐ Communication with volunteers
- ☐ Doorhangers
- ☐ Other, please specify
- ☐ They are not directly informed

Q13. Please explain what other methods you use to keep visitors informed about the presence of the ordinances in place within your community.

Q14. Which of your community's coastal conservation ordinances were created specifically for the purpose of improving the protection of sea turtles? Please select all that apply.

- ☐ Limit artificial lighting from beachfront property and buildings
- ☐ Limit the use of flashlights on beaches, or require use of a red light filter
- ☐ Restrict what objects can be left on beaches at night
- ☐ Restrict vehicle access on beaches
- ☐ Restrict dog access on beaches
- ☐ Limit public access on beaches at night
- ☐ Restrict mechanical beach cleaning operations
- ☐ Limit the construction of sea walls and/or other forms of coastal armoring
- ☐ Prevent destruction of sand dunes
- ☐ Prohibit campfires on beaches
- ☐ Limit "special events" on beaches
- ☐ Limit digging large holes
- ☐ None of the above

Q15. To what extent is sea turtle conservation a topic of interest among the general public in your community?

- ☐ No interest
- ☐ Little interest
- ☐ Unsure
- ☐ Some interest
- ☐ Significant interest

Q16. How effective are the education and outreach efforts offered by your community in terms of generating public awareness about sea turtle conservation?

- ☐ Not at all
- ☐ Somewhat effective
- ☐ Not sure
- ☐ Average/Neutral
- ☐ Moderately effective
- ☐ Highly effective

Q17. Please describe the public education and outreach initiatives within your community with regard to sea turtle conservation.

Q18. Is sea turtle nesting activity monitored on the beaches within your community?

- ☐ Yes
- ☐ No
- ☐ Not sure

Q19. Please list the name of the sea turtle monitoring organization(s) below.

Q20. How frequently do monitoring efforts take place during the sea turtle nesting season?

- ☐ 1-2 times per season
- ☐ 1-2 times a month
- ☐ Once a week
- ☐ 2-3 times a week
- ☐ 4-6 times a week
- ☐ Daily

Q21. Do designated "conservation zones" or "preservation zones" exist for sea turtles within your jurisdiction?

- ☐ Yes
- ☐ No
- ☐ Not sure

Q22. To what extent are sea turtle nests clearly marked on the beaches within your jurisdiction?

- ☐ Never
- ☐ Rarely
- ☐ I'm not sure
- ☐ Sometimes
- ☐ Always

Q23. Has a sea turtle habitat conservation plan been adopted within your jurisdiction?

- ☐ Yes
- ☐ No
- ☐ Not sure

Q24. Which of the following best describes the extent that coastal armoring (such as seawalls, revetments, and groins) is present within your jurisdiction?

- ☐ There is absolutely no armoring on the beaches
- ☐ There is little to no armoring on the beaches
- ☐ The beaches are somewhat armored
- ☐ A significant portion of the beaches have some form of coastal armoring
- ☐ The beaches are almost completely armored
- ☐ I'm not sure

Q25. How would you rate the overall level of success of your community's sea turtle conservation efforts?

- ☐ Not at all successful
- ☐ Not very successful
- ☐ Unsure
- ☐ Somewhat successful
- ☐ Highly successful

Q26. To what extent do you agree with the following statement:

"More could be done to improve sea turtle conservation efforts within my jurisdiction."

- ☐ Strongly disagree
- ☐ Somewhat disagree
- ☐ Unsure
- ☐ Somewhat agree
- ☐ Strongly agree

Q27. What else do you think could be done to improve sea turtle conservation efforts within your jurisdiction?

Q28. What are some of the challenges associated with sea turtle conservation efforts within your jurisdiction?

Q29. What other coastal conservation issues are most important to your community?

Q30. What coastal conservation challenges does your community struggle with?

Q31. Please enter your name and email address below.

- ☐ Name

- ☐ Email

Your information is confidential and will not be shared with any third parties. Survey results are reported in aggregate and are not attributed to you or your department, organization, or company.

End of Survey.

APPENDIX B

SUPPORTING PHOTOS: PERSONAL DOCUMENTATION OF SEA TURTLE NEST PROTECTIONS AT VARIOUS BEACHES THROUGHOUT THE SOUTHEASTERN UNITED STATES



Marked nests located on toe of primary dune, seaward from development in Isle of Palms, South Carolina.



A “raceway” to help guide hatchlings towards the sea to combat the effects exposure to artificial lighting sources in the Florida Keys.



A marked sea turtle nest amidst visitors to Sombrero Beach, a popular recreational destination on Marathon Key, Monroe County, Florida.



Signs posted before beach access point at Indian Rocks Beach in Pinellas County, FL.