

Fort De Soto Park and Mullet Key: Beach Processes, Management, and History

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Introduction

Fort De Soto Park is located on an ever-changing barrier island with an abundance of birds, sea life, and plants. It is the largest park in Pinellas County. Located on the north side of the mouth of Tampa Bay, Fort De Soto Park is a component of the Pinellas County park system and consists of Mullet Key and four smaller islands. The islands (often called keys) have varying landscapes with sandy beaches, mangroves, wetlands, palm hammocks, and hardwood areas. Together the five keys total more than 1100 acres with over six miles of beach frontage. The annual park attendance averages more than 2.7 million visitors. The park has a wide variety of amenities with an 800-foot-long boat launching facility, a family camping area and primitive youth camping area. The park also has 15 picnic shelters and playgrounds. Park Superintendent, James Wilson (personal communication, 2014), relates that the charge of the park is to protect the natural resources there while, at the same time, maintain the recreational activities and the wildlife habitat. These can, at times, run counter to one another.

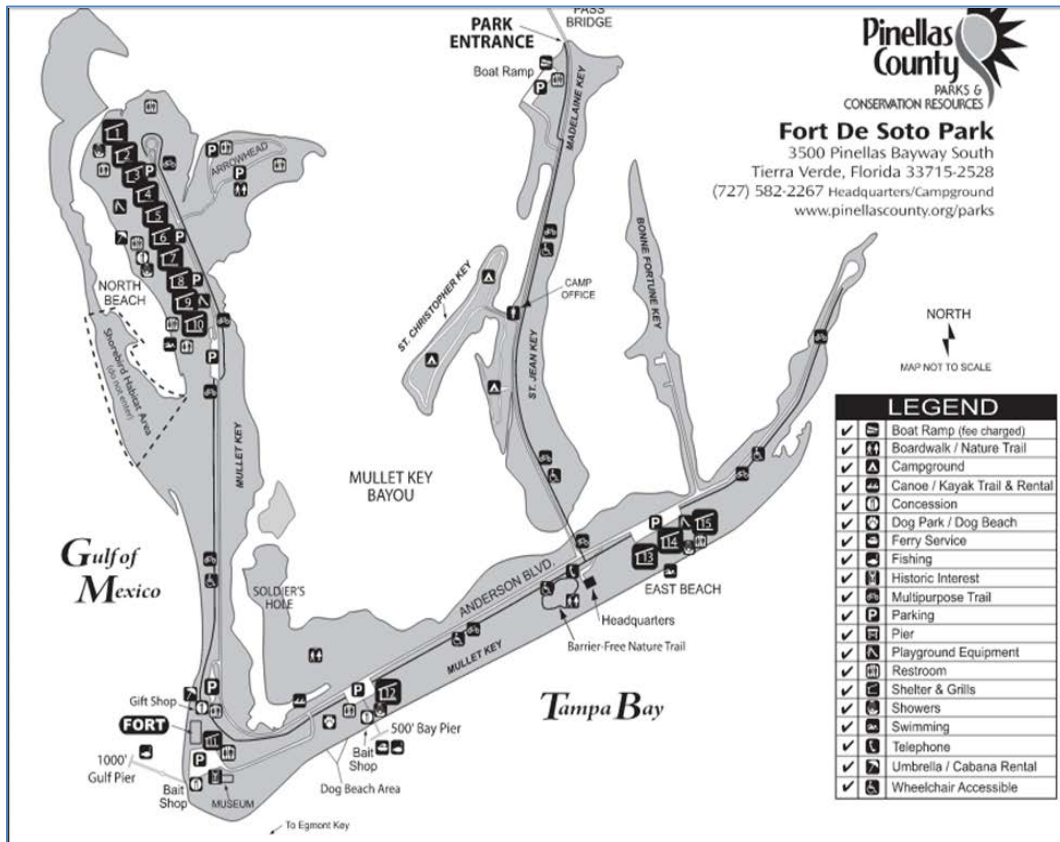


Figure 1. Ft. De Soto: Pinellas County Parks and Conservation Resources

The park is accessible from the Pinellas Bayway; toll required, at exit 17 from I-275 in south St. Petersburg. Most of Fort De Soto Park is situated upon Mullet Key, but smaller islands include Bonne Fortune, St. Christopher, St. Jean, and Madelaine Keys (Figure 1). Mullet Key is bounded on the north by Bunces Pass with a significant offshore sand deposit, and on the south by Egmont Channel. Figure 1 shows the L-shape form of Mullet Key, its west facing, wave dominated section and its tidal dominated south facing portion. The Gulf of Mexico (GOM) likely dates from Jurassic times and has been relatively stable tectonically since its initial formation (Ellis and Dean, 2012). The central portion of the basin, though, continues to subside. The continental shelf extends offshore from southwest Florida about 150-200 km and is nearly flat with a very gentle seaward slope. The average depth in the GOM is approximately 1600m while the deepest portions reach to near 4000m.

The Gulf of Mexico and its Geomorphic Setting

The GOM has been subdivided into 8 geomorphic regions, and are numbered G-1 through G-8 counterclockwise from the Florida Keys (Ellis and Dean, 2012). The subdivisions are based upon similarities in littoral conditions, wave energy, geology and sediment supply. The central Florida Coast, region G-3, where Fort De Soto is located, is characterized by numerous sandy spits and islands, eroding beaches, inlets connected to salt marshes and back bays. In general terms, this area is to a degree, sand starved, thus resulting in degrading beaches and the need for periodic beach nourishment.

Circulation in the GOM is dominated by the cyclic Loop Current, which moves water from the Yucatan Channel, north toward the mouth of the Mississippi River, then south to the central Gulf and east through the Florida Straits (Ellis and Dean, 2012). The northern portion of the Loop Current occasionally breaks off and the gyre drifts westward as the current rebuilds northward into the GOM. The Loop Current is largely responsible for the north to south movement of water along the edge of the continental shelf offshore from the western portion of the Florida Peninsula, though there are seasonal and local differences in the circulation pattern.

History of the Site

Paleo Indians occupied the Florida Peninsula beginning more than 12,000 years ago (Florida Department of State, 2014); however, at around 12,000 years before present (kybp), the west central Florida coast line was as much as 120 to 150 km west of the present day location of Fort De Soto Park and Mullet Key (Hine, 2013). Coastal occupation sites from that time frame would be situated below present day sea level, far offshore into what is now the GOM. The topography at that time was a gently undulating upland, underlain by limestone. Water would have been available at various springs and hunting, gathering, and fishing were primary modes of sustenance. There are few archeological sites that have been identified from this Paleo Indian period in the region, however.

Sea level began to rise after about 14 to 12 kybp, and Native Americans continued to occupy village sites along the west coast of Florida. Sea level had more or less stabilized by around 6 kybp and as a consequence numerous sites have been located and documented from this Archaic period. Shell middens with many artifacts, including pottery shards, stone and bone tools, fish

and mammal bones, and charcoal, are widely distributed in the region, including in the vicinity of Mullet Key.

Spanish occupation of the west coast of Florida began after 1528 when Panfilo de Narvaez explored the barrier islands (Pinellas County Historic Guide, 2014). Hernando De Soto began his lengthy expedition into the southeastern portion of the United States in 1539. After the time of contact with Europeans, Native American occupation of southwestern Florida was changed significantly resulting in the disintegration of large occupation sites, outmigration, and abandonment of traditional lifestyles.

Modern use of the site followed an extensive survey of the coastline in 1849 for potential military defense positions (Pinellas County Historic Guide, 2014). Robert E. Lee was a part of that survey team. Mullet Key and nearby Egmont Key to the southwest were recommended for military outposts. Though no fortifications were in place there during the Civil War, Union troops temporarily occupied some of the islands to prevent movement of Confederate troops through Tampa Bay. The sites were abandoned in the wake of the Civil War until 1882 when the military reestablished its presence on Mullet and Egmont Keys.

The Spanish American conflict prompted construction of a fort, beginning in late 1898, as a measure to protect Tampa Bay from possible Spanish invasion. Initially, a wharf, offices, dining facilities, a stable, a short, narrow gauge railroad, and quarters for workmen were constructed. The fort was built between 1898 and 1906, which remained active until 1910. The complex of buildings included a substantial barracks, hospital, guardhouse, administration buildings, and warehouse facilities.

The fortification employed a concrete mixture including shells and stone. The shells remain evident in concrete structures. The fort was designed so that enemy ships would not be able to see the gun emplacements since the batteries facing the Gulf of Mexico were buried in sand and vegetated (figure 2). The soil and vegetation camouflage also resulted in a significant increase in protection from the newer rifled cannon commonly aboard ships at that time. Rifled cannon from that period had a range of several kms. Thick poured concrete walls and ceilings afforded substantial protection. Though the fort was never used in combat, maneuvers were conducted there several times, and it remains significant in terms of the evolution of modern weaponry. The gun emplacements included mortars, which could lob nearly ½ ton shells over the walls, from about 2 to 10 km offshore and two rapid fire, 3 inch guns, with a 7 km range (figure 3). Examples of both are on display at the park.



Figure 2. Camouflaged and Vegetated Fortifications at Fort De Soto



Figure 3. Mortars behind Poured Concrete Walls

Fort De Soto housed as many as 125 soldiers. Buildings at the site were constructed of wood with slate roofs. Sidewalks and roads, and a water and sewer system completed the post. An artesian well supplied water, distributed by way of pipes, for washing, while rainwater was collected and used for drinking. Mullet Key was also used as a quarantine station from 1889 to about 1937 where immigrants were examined and treated before being allowed into the United States. After 1910, the outpost was downsized and only a few troops remained. With the outbreak of World War I in 1914, approximately 30 soldiers were posted to the fort. In 1923, the fort was officially abandoned; tropical storms and hurricanes eroded the beach and damaged many of the buildings. The US Army sold the site to Pinellas County in 1938. The U.S. Army Air Corps reacquired the land in 1941 for use as a bombing range and became a part of Tampa's MacDill Field. After World War II, Pinellas County repurchased the land in 1948, extending a causeway from the mainland in 1962, enabling access by automobile for the first time. Fort De Soto Park was officially dedicated in 1963.

Beach and Shoreline Processes

Beaches in general are dynamic and GOM examples are no exceptions. Over relatively short time frames, they can both aggrade (migrate seaward) and degrade (migrate landward); some have disappeared in a single storm. Sometimes aggradation and degradation are visible along the same beach. Shorelines adjust in response to several factors, including: sea level change, variation in sand supply, tides, currents, storms, and bulldozers. Barrier islands and their associated beaches on the west coast of Florida are impacted by long term, short term and episodic changes (Clayton, 2012). Long term changes occur over decades to thousands of years due to sea level rise and fall, and climatic change. Short term changes span a decade or so and might include the opening of an inlet or the development of a dune. Episodic change occurs when surge, over wash, waves, and currents from a single storm redistribute sand resulting in dune loss or breach of an island to form a pass.

Sea level rise results in beach retreat landward. Sea level increased at very low rates over the past 7000 years; but, a marked rise has been observed since about 1900. Many beaches reflect this rise and are thus in retreat. Sea level rise along much of west coast peninsular Florida averages about 0.15m per century (Clayton, 2012). However, other factors can compensate for sea level rise and the beach may actually aggrade. Sand supply varies over both the short and long term. Longshore drift moves large amounts of sand along the Gulf coast but locally this supply can be impacted by changes in offshore sand bars. Groins extending into the water will accumulate sand on the up-drift side and lose sand on the other side. Sands may be redistributed by beach erosion from dunes being swallowed by wave action in one location, only to be added to the sand supply in another nearby spot. Channel dredging can also negatively impact the sand supply down drift. Sand in transport can "hang up" at deepened channels.

The subtropical ridge of high pressure extends over north Florida much of the year with predominant easterly wind flow across the peninsula. The dominant offshore wind results in low wave energy on peninsular Florida's Gulf coast. During much of the year, when the ambient wind is light, offshore land breezes develop overnight with sea breezes blowing onshore during the afternoons. The GOM is a smaller basin which limits the distance that winds can blow across water and develop larger waves. The largest waves along the peninsular gulf coast occur with strong winds from both tropical cyclones during the summer and fall and with cold fronts during the cool season. Waves in the Big Bend area are very small with an annual average height of

about a half meter while to the south along the central peninsular coast, wave height averages are even lower (Clayton, 2012).

Sand supply is dependent upon longshore drift. Longshore drift direction tends to be seasonal. Cold frontal passages associated with winter storms develop a north to south pattern during winter months while southwesterly winds tend to reverse the direction of drift (Clayton, 2012). Often the direction of longshore drift is evident from an aerial image of the barrier island. Cusps at the south end of West Coast Florida barrier islands indicate a north/south sand drift with island building on the south end. If that sand supply is disrupted, beach processes will quickly reshape the island. Where an inlet or pass opens to the Gulf, a tidal delta of sand often develops, such as at Bunces Pass. This sand can be rearranged by longshore drift and become part of the sand supply for beach aggradation. The channel associated with Tampa Bay has a significant amount of sand moving from the Bay, offshore, adding to the sand supply for barrier islands and beaches to the south. That sand is then rearranged by way of longshore drift.

Tidal variation has the ability to move sand around on barrier island beaches and can influence the impact of water level changes from frontal passage storminess, tropical storms, and hurricanes. If a storm approaches and makes landfall at high tide, a more significant rearrangement of the beach is an expected outcome. If the sun, earth and moon are aligned, a resulting spring tide can result in even greater beach modification.

Development, bulldozers, channel dredging, sea wall and groin construction, and beach replenishment all impact beach processes. Sand sources for natural beach replenishment have been negatively impacted over the last century or so by dredging channels, which reduces longshore drift. Additionally, dam construction, such as in Parish in Manatee County, holds back sediments behind the structures, which in former times were transported to the nearshore environment and were available for natural redistribution.

Dunes in the Barrier Island Environment

Dune formation is dependent upon a sand supply, prevailing winds, and a disruption of the wind flow. Wave action delivers sand to the beach and there winds can blow at a force sufficient to overcome the sand's inertia of rest (Clayton, 2012), interlock of the grains, and "stickiness" associated with the salt which can provide hygroscopic adhesion of the particles. Sand grains will then become airborne until even the slightest obstruction causes a change in flow where particles can then drop out of suspension. When a grain strikes the surface, other particles may be dislodged and become part of a "train" of grains saltating across the beach, in effect, a chain reaction (Ritter et al., 2011). Obstructions might include a pebble, a shell, a piece of driftwood, or a plant. When grains come to rest in the lee of such an obstruction, the influence of that obstruction is enhanced, adding to its ability to further disrupt flow and cause additional sand accumulation. In order, however, for that small sand accumulation to become a more permanent component of the beach, some mechanism for stabilization is required. The stabilizing effects of vegetation will be covered later.

The Florida peninsula's west coast dunes are generally modest, linear, and usually only a few meters or less in height. This is explainable on the basis of sand supply, prevailing wind direction and speed (Clayton, 2012). Other shorelines exhibit impressive dune networks, such as Cape Hatteras, NC, where sand supply is greater, and where wind direction and speed are more amenable to dune construction. Even Panhandle Florida dunes are more impressive owing to differences in these same variables.

The dune environment can be subdivided into a number of partitions. The foredune develops landward of the beach zone. Foredunes on Florida's west coast are often low, linear and vegetated with plants that are salt tolerant and wind and drought resistant. Plants at this location are subject to high wind speeds during storms, salt deposition, storm waves, high temperatures, soil with few available nutrients, and little organic matter to hold moisture (Clayton, 2012). Such plants can be regarded as pioneer species in terms of plant succession. An interdune lowland, sometimes termed a swale, often parallels the foredune (on the landward side) and can sometimes support a temporary pond or wetland. Since the soil moisture regime is so very different from the foredune, an entirely different plant association is likely to inhabit the swale. Beyond the swale, other chains of dunes can be present on a stable or aggrading shoreline.

Sand on west coast Florida beaches varies significantly from north to south. In the northern portion of the peninsula, fine grained quartz sands dominate, while further south, shell fragments become more common, and at the southern end of the peninsula, quartz sand is scarce (Hine, 2013). The quartz sand originated from the Appalachian mountain chain in North Georgia and Alabama. The metamorphic, igneous, and some sedimentary rocks of the Appalachians and the Piedmont provided copious quantities of very durable quartz grains (Hine, 2013). Weathering, erosion, and transport by streams such as the Apalachicola River brought sediments into peninsular Florida at higher sea stands and into the Big Bend area where the peninsula joins the panhandle. Much of this sand dates back many millions of years, was "in storage" for a considerable time, and has been eroded and transported for redistribution by modern currents, tides, and wave action (Hine, 2013). Sand supply currently is limited; beaches are naturally resupplied by way of erosion of other beaches and dunes, sand bars, and tidal shoals, followed by redistribution from currents. A hand lens can be used to differentiate the type of sand at any beach. Quartz sand particles are fine-grained, frosted, and generally rounded, while shell fragments are more opaque, larger, and angular in form.

Dunes are integral to beach preservation and can provide substantial protection to structures away from the beach and preserve barrier islands. In many areas, steps have been taken to ensure dune preservation, and some dunes have been artificially enhanced. A later section will explain this in greater detail.

Artificial Beach Building and Beach Nourishment Activities

Beach aggradation and degradation are variable and ongoing processes. Fort De Soto beach is a very dynamic environment (Fort De Soto Park Superintendent James Wilson, personal communication, 2014). Real estate development, beach front properties, and significant investments in recreational use of barrier islands puts pressure on authorities to augment a degrading beach resource. Geoengineering techniques have temporarily reduced the impact of shoreline retreat in many places. Such practices date back decades and have been employed in Brazil, South Africa, Australia, New Zealand, Japan, the United States and countries in Europe (ASBPA, 2014). Dozens of beach nourishment projects have been completed, are in progress, or are in the planning stages on Florida's west coast (Clayton, 2012).

Beach nourishment presents both advantages and disadvantages (Barber, 2014). It will widen, restore, and increase the recreational potential of beaches. Enrichment provides a measure of protection to structures inland from the beach, if only temporarily. Disadvantages are significant (Barber, 2014; ASPBA, 2014). Studies show that nourished beaches erode at rates 2 to 3 times faster than that of natural beaches. Lifetimes of augmented beaches, though, remain

unpredictable because storm activity is so irregular. Wider beaches last longer. Small beach nourishment projects can cost millions of dollars, while larger ones designed to last longer can run into the hundreds of millions of dollars. Matching the transported sand to the original beach is difficult and the match has esthetic and biological implications. A larger grain size can, for example, impact sensitive shore nesting birds, which have become accustomed to a particular sort of sand over hundreds of generations. Different sized sand grains may erode at a rate different from the original beach sand.

Beach structures such as berms, developing during storms, can negatively impact sea turtle nesting. Sea turtles may build nests too close to the tidal zone, attempting to avoid a steep climb on a beach structure that may not have existed prior to nourishment (Clayton, 2012). Dredges with vacuum pumps indiscriminately remove sand and all of the organisms living upon and within the seafloor environment. Once materials are delivered to the beach, back beach vegetation is destroyed. Organisms living in the sand column are crushed from heavy equipment traffic, and sand is compacted (Barber, 2014). While dredging and pumping continue, turbidity increases substantially, but usually only temporarily unless the material contains substantial amounts of silt and clay which will remain in suspension for a longer duration than quartz sand. Turbid water can drift into other areas not being nourished and negatively impact those environments as well.

Inland and offshore sources of sand have been employed. Inland sources are often unsuitable and expensive. Inland sand sources require transport of huge volumes of material, disruption of traffic flow while being transported, negative impact upon land values where sand has been removed, ecological damage stemming from sand dredging in back bays and lagoons, depletion of these resources, contamination from heavy metals and other contaminants, and in the case of lagoonal sources, organics and silt/clay materials. Therefore offshore sources, hopefully adjacent to the point of application, have been sought (Finkl et al., 2007).

Planning for beach enrichment must take into account the character of the sand in place, to be augmented, and that of the material to replenish sand lost to erosion. Color, grain size, silt and clay content, and the presence of heavy minerals are characteristics that must be addressed. Beach users do not like dark sands to be emplaced as they are less esthetic than the snowy, quartz sands, and their ability to absorb abundant sunshine, and subsequently heat up, makes use of the beach a problem. Coarse grain sizes, abundant shell fragments, and iron stains are also less desirable (Clayton, 2012).

Offshore sources of suitable sand have been identified using a broad array of techniques in the west coast Florida region. Potential borrow areas have been identified in various studies using techniques such as sub-bottom seismic profiling, grab samples, vacuuming, and vibracores. Once collected, sand samples can be subjected to particle size grading, tests for color, and silt/clay content.

An entire industry has grown up around the desire to maintain the integrity of beach environments. Beach replenishment is a “soft” shore stabilization technique as opposed to “hard” geoen지니어ing strategies which employ sea walls, revetments, breakwaters, rock or wooden groins, and other protective strategies. It is well known that beach augmentation is but a temporary fix in an eroding beach environment, but it is also seen by some as useful, practical, and necessary to protect valuable real estate. Beaches serve as a natural buffer to inland areas and also serve as recreational resources, justifying significant investments designed to protect them.

Finkl et al. (1997) and Finkl et al. (2007) describe a variety of methods employed to locate offshore sand resources in the area of Fort De Soto Park. They initially used navigational charts to infer seabed geomorphology. A Trimble Global Positioning System allowed them to maintain locational aspects of the seafloor character. Using seismic profiling, they were able to determine sediment thickness. Sampling techniques allowed identification of sediment resources with suitable grain size, color, and abundance.

The offshore beach nourishment process is complex and expensive. Heavy equipment is involved in both the offshore and onshore environments. Beach nourishment employs barges anchored offshore with hydraulic pumping capacity. Sand is dredged from the seafloor and pumped as a slurry either onto the beach directly, or into shallow water, just seaward of the beach. In other cases, large vessels with hydraulic pumping capacity are anchored offshore where the sand is pumped onto smaller barges, with less draft, and then hauled closer to shore. There, the material is piped onto the beach or into shallow water for redistribution by wave action. When the sand is piped directly onto the beach, it is redistributed by earth moving equipment. Direct emplacement of sand onto the beach likely produces better results in terms of beach building, while it is more disruptive to wildlife and vegetation. Placement of sand just seaward of the beach is less disruptive, but somewhat less effective (Olson Associates, 2010).

Dune Grasses as a Mechanism for Beach Stabilization

Intact foredune ridges are key to preserving barrier islands (Miller et al., 2003). Maintaining the continuity of these dunes is difficult in light of tropical storms along the west peninsular coast of Florida. Tropical storms often result in wave attack, dune fragmentation, overwash, and storm surge.

Dune building strategies include importation of sand, trapping of sand on the beach, and planting of dune vegetation (Clayton, 2012). Sand may be trucked in, sculpted into dunes and stabilized with plants able to withstand harsh environments presented by the foredune. Or, sand can be trapped with fences which are designed to disrupt aeolian transport from the beach, emplacement of the sand after it falls out of suspension, and subsequent vegetational stabilization.

Suitable dune stabilizing species include varieties of sea grasses such as sea oats (*Uniola paniculata*) and panic grasses (*Paniculum* sp.). Sea purslane, southern sea rocket and others will also colonize an embryonic dune. These plants can be regarded as pioneer species. When a beach zone stabilizes sufficiently, the sea rocket and purslane may become established, allowing for native grasses to invade. Working together, stabilization is enhanced and the dune may grow both horizontally and vertically.

Plants must be able to withstand harsh conditions in the foredune environment to be useful as dune stabilizers and dune builders (Clayton, 2012). Additionally, plants should be perennial, in that once established, they continue to grow year to year.

To increase dune presence on Florida beaches, their development has been artificially encouraged. Dune fences have been installed and grasses planted as strategies to encourage dune growth (Clayton, 2012). Sea oats and panic grasses have been planted in echelon on many Gulf Coast beaches to encourage sand dune building.

Fort De Soto Beach Park Features

With an annual park attendance averaging more than 2.7 million visitors, Fort De Soto Park receives more visitors each year than many United States national parks (Fort De Soto Park Superintendent James Wilson, personal communication, 2014). A few examples include Arches National Park, Utah, with approximately two million visits per year, while Canyonlands, also in Utah, numbers around one million and nearby Everglades National Park just under one million (National Park Service, 2014). Visitor usage is therefore very high per unit area especially considering the fact that Canyonlands, Arches, and Everglades cover hundreds of thousands of acres while Fort De Soto has approximately 1200 acres.

Fort De Soto Park is no exception to the statement that Peninsular Florida Gulf Coast beaches are dynamic and in a constant state of change. A comparison of maps and aerial photographs over recent decades (<http://pubgis.co.pinellas.fl.us/pairs/index.cfm>) shows that the beaches have both accreted and eroded. In some areas, erosion removed significant amounts of shoreline while in others, accretion is evident. Therefore, longshore currents are variable within fairly short time frames and over short distances. James Wilson (Fort De Soto Park Superintendent, personal communication, 2014) notes that the park covered about 970 acres in 1970 while the area today is closer to 1140 acres due to accretion.

An intensive campaign was recently launched in 1998, continuing today, to preserve and increase beach presence in the park. Dunes are integral to beach preservation and restoration. A goal is to increase the size, both horizontal extent and height of dunes at Fort De Soto, which included the planting of hundreds of thousands of sea oats (Fort De Soto Park Superintendent James Wilson, personal communication, 2014). Figure 4 shows newly established sea oats at Ft. De Soto, planted in echelon, after 5-6 weeks in the ground. The plants trap wind-blown sand by disrupting the saltating grains. Figure 5 shows a dune planted with sea oats in 1998. A comparison of the newly established plants (Figure 4), and those from a decade and a half ago (Figure 5) exhibits considerable change. The lines of protection are quite evident in this series of photos.



Figure 4. Newly Established Sea Oat Plantings, Fort De Soto Beach (2014)



Figure 5. Sea Oat Stabilized Dune Planted in 1998, Ft. De Soto Beach

After the dune becomes established, other pioneer plants invade, including sun flowers, sea grape, and purslane. Nearly one million sea oat clusters were planted at Fort De Soto over the past 15 years. The rhizomes are propagated nearby from seeds harvested at the park. A cooperative agreement with the grower, who uses seeds harvested there for growing plants sold to other customers, allows for a very economic planting program.

Australian pines (*Casuarina* sp., Figure 6) were introduced to Florida around 1890 to provide shade, serve as windbreaks, and for erosion prevention (Teachers Guide, 2014). Not related to pines, they are evergreen and quickly became a part of the landscape. They are droopy, gray-green, needle leaf-like, and often large trees. The leaves are actually not like those of familiar conifers, such as white or red pine, but are segmented, like horsetails. They are invasive and regarded now as pests for a number of reasons. First, they readily propagate on poor, sandy soils. They resist the toxic effects of salt spray and thus can survive on the inland side of beaches. Their ability to fix nitrogen gives them a competitive advantage over slower growing and reproducing species native to the Florida Peninsula. Additionally, *Casuarina* sp. is also allelopathic in that it suppresses the growth of native species through the release of a toxic substance in the leaf litter beneath the trees. The understory of these trees is nearly void of any other plants.



Figure 6. Australian Pine at Ft. De Soto Park

Australian pines are shallow rooted and thus subject to wind throw during tropical storms (FWC, 2014). Native species are more deeply rooted, having evolved in a tropical storm prone environment, and can withstand higher wind speeds. Finally, Australian pines are regarded as pests because their dense root system impacts the ability of green sea turtles and loggerhead turtles for example to dig nest sites above high tide line on the back of beaches (FNPS, 2014).

An effort is being made to reduce the number of the Australian pines at Fort De Soto Park. Eradication is not possible, though a reduction in numbers is a realistic goal (Fort De Soto Park Superintendent James Wilson, personal communication, 2014). Plans include removal of the trees nearest the shoreline first, followed by those further ashore. Approximately 10% of the invasive trees will be removed annually so as to not expose too much shoreline to coastal erosion at once (Fort De Soto Park Superintendent James Wilson, personal communication, 2014).

Beach Nourishment at Fort De Soto

The beach at Mullet Key has been nourished a number of times since the 1960s (Pinellas County Management Plan, 2014). In 1964, approximately 140,000 cubic yards of trucked in material enriched about 1.3 km of beach (Trembannis and Pilkey, 1998). In 1973, a protective strip of beach was added involving over one half million cubic yards of material pumped from offshore. A partnership with the U.S. Army Corps of Engineers in 2006 resulted in a “dredged material project” where sand removed from the entrance to Tampa bay was emplaced at Egmont Key and Fort De Soto Park. About 200,000 cubic yards of material were added to the Fort De Soto beach environment during this project (Pinellas County Management Plan, 2014). This material contained more shell debris than the native quartz rich sand. A hand lens examination of sand samples from along the beach reveals the areas retaining a higher percentage of fine grained quartz sand.

Along the Fort De Soto Beach, hot spots, are locations where overwash has occurred in recent history and where beach recession is obvious. The beach is narrow and the back bay is easily visible just beyond the dunes. One location, at the time of this writing, where Australian pines were being removed and waves were gently lapping at their severed stumps, there was barely any beach remaining (Figure 7a and b). Another location which shows significant beach recession is near the pier, by the fort, where concrete remnants from the old fort are all that remains of the original structure. These locations may require nourishment in future years.

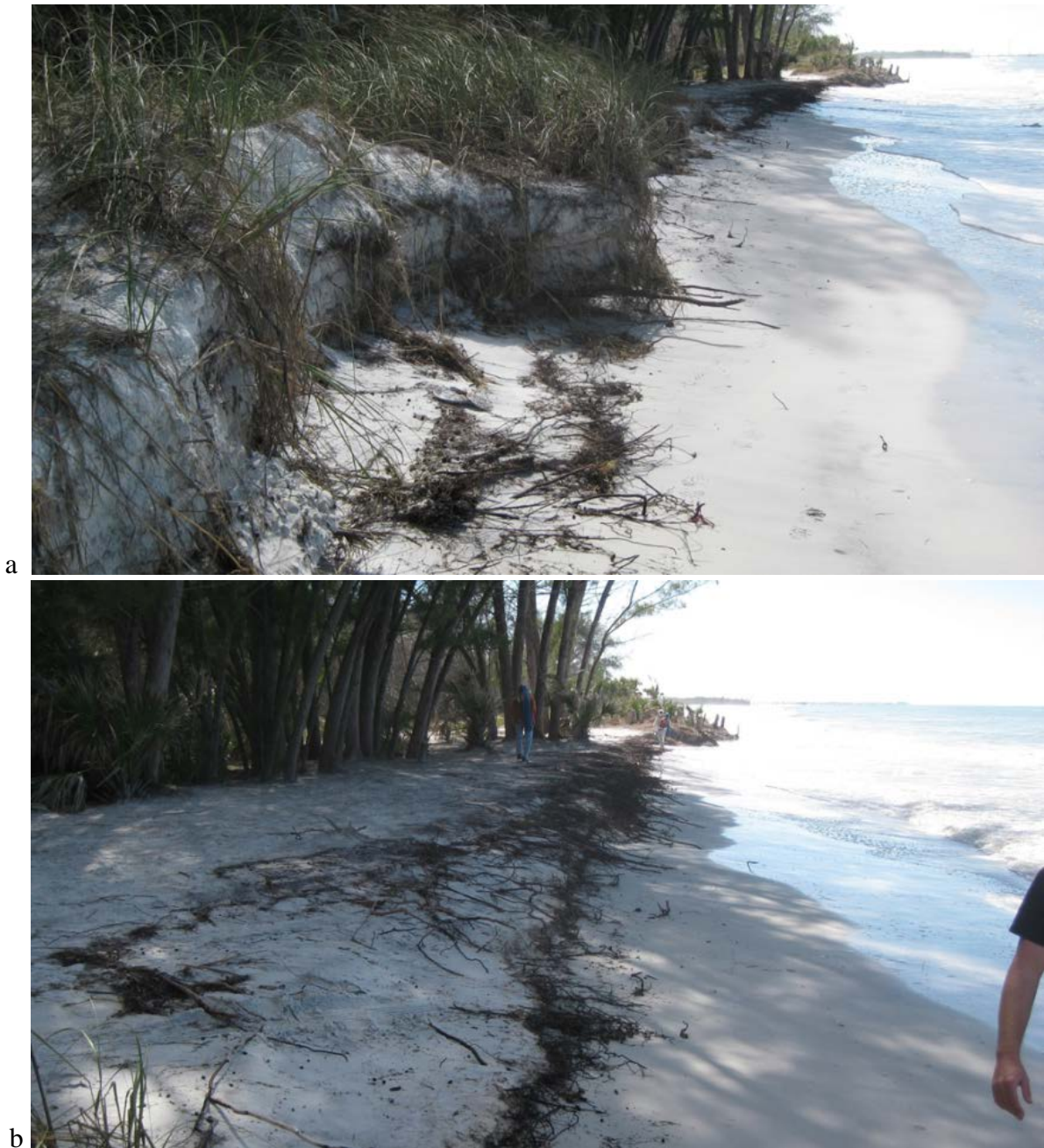


Figure 7a and b. Narrow Beach where Australian Pines have been removed

Since beach erosion and over wash are constant worries at such a facility, workers exercised great care when recently enhancing access to the fort. Trails through dunes, perpendicular to the beach, are paths of least resistance during a storm surge or high wave energy events. Such paths can conduct wave energy and water through the dune barrier, allow for enhanced down cutting, widening, and occasionally even dune removal. The end result can be a very large opening and perhaps even a new channel (Fort De Soto Park Superintendent James Wilson, personal communication, 2014). To mitigate the potential loss of the barrier dune, a clever landscape

design allows for handicap access to the beach where the ramp parallels the dune face instead of cross-cutting it (Figure 8).



Figure 8. Beach Access Ramp Parallels the Long Axis of the Beach

Summary

Fort De Soto is located in a dynamic barrier island environment and can serve as a field laboratory for students. The islands contain sandy beaches, mangroves, wetlands, palm hammocks and hardwoods. It effectively shows shoreline retreat, aggradation, beach nourishment, and artificial dune augmentation. Concepts of coastal geomorphology, planning, tourism, and recreation are amply demonstrated in a compact, accessible setting.

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