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Excerpts from *Coastal Dunes, Dune Protection and Improvement manual for the Texas Gulf Coast,* fourth edition. http://www.glo.state.tx.us/coastal/pdf/DuneManual.pdf The original contributors to this manual were Michael H. McKann, Jerry McAtee, John Campbell, Eddie Seidensticker, Ray Quay, Craig Stafford and John Taylor. Revisions by Kimberly K. McKenna…. Critical Reviews by James C. Gibeaut, Bureau of Economic Geology, University of Texas at Austin, and by Land Office Coastal Resources and Legal Services staff improved the content of the manual. It is a publication of the Texas General Land Office.

{Comments by RLW in curly quotes, like these.}

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As a resilient natural barrier to the destructive forces of wind and waves, sand dunes are the least expensive and most efficient defense against storm-surge flooding and beach erosion. Dunes absorb the impact of storm surge and high waves, preventing or delaying intrusion of waters into inland areas. Dunes hold sand that replaces eroded beaches after storms and buffer windblown sand and salt spray. This natural defense can be strengthened by increasing the height and stability of existing dunes and by building new dunes.

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The growth of mainland coastal population centers and the increasing development and recreational use of the barrier islands can impact the stability of the dune environment. Construction and heavy recreational use of the beaches can contribute to fragmentation of the beach/dune system and deterioration of dunes. The vegetation that secures sand is destroyed, sand is lost, and the dune line is breached by roads, trails, and storm runoff. Dune damage that results from human activities accelerates the damage caused by wind and wave erosion.

Inland areas become more vulnerable to hurricanes and tropical storms when the dune line is weakened. Protecting dunes helps prevent loss of life and property during storms and safeguards the sand supply that slows shoreline erosion. Protecting dunes also preserves and enhances the beauty of the coast and coastal ecosystems.

To succeed, dune improvement and protection efforts must be undertaken by federal, state, and local governmental entities. But even more valuable are efforts by those who live on the coast.

The Texas Coast will continue to attract Texans and other visitors in ever-greater numbers for years to come. This manual describes measures that landowners, city and county planners, developers, and industry can use to preserve sand dunes and promote dune restoration on the coast so that future generations can enjoy the natural beauty of the Texas Coast.

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Critical dunes are all dunes (coppice mounds, foredunes, foredune ridge, and some backdunes) that store sand to replenish eroding public beaches.

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The Sand Cycle

Beaches and dunes are integral parts of a dynamic environment in which sand is constantly exchanged.

During the calm conditions that prevail throughout most of the year on the Texas coast, waves average two to four feet in height and are less frequent than during storms. These calmer waves transport sand from offshore bars and the surf zone to the beach, causing the beach to gradually build up, or accrete. In time, sand is blown onto the foredune, where it is trapped by vegetation and stored until displaced by storms.

During a storm, high-energy waves flatten the beach. Waves washing against the base of the foredunes erode sand, undermining and collapsing the seaward dune face. In severe storms, the dune face commonly recedes several yards — in extreme cases as much as 100 yards — leaving a steep cliff **(fig. 2)**. Sometimes dunes are completely destroyed. Retreating waves carry the eroded sand offshore and deposit it just seaward of the surf zone in large bars. This process of dune erosion and sand movement dissipates much of the energy of storm waves. Sandbars also dissipate storm wave energy by causing waves to break further offshore.

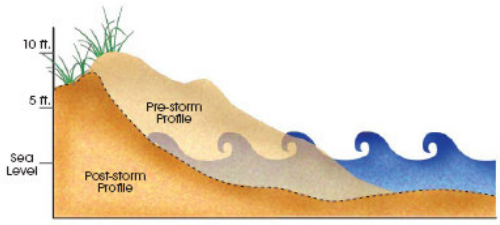

Figure 2. Result of storm waves on beaches and foredunes.

If the supply of sand remains constant, the natural exchange between the beach, dunes, and offshore areas will repair and rebuild dunes to a height and width determined by local conditions. However, the loss of vegetation that traps and holds sand makes the beach and dunes more susceptible to wind and water erosion, thus inhibiting their recovery from storms. Bays, channels, marshes, and grass flats behind the weakened foredune are exposed to storm-surge flooding and to accumulation of windblown sand.

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Eventually, following a storm, the natural beach/dune system can recover its pre-storm shape if enough sediment is available in the littoral system. In Texas, this process can take up to five years, first by beach accretion, then by dune formation, expansion, and vegetation colonization. Sometimes this process is interrupted by structures, such as buildings, that prevent winds from blowing sand that is necessary for dunes to form.

{Actually full recovery can take many decades after severe erosion.}

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dune development in areas downdrift of them. In general, rigid structures are less efficient than the naturally resilient dunes as defense for the beach against storm surge. The beach directly in front of a vertical seawall may be eroded by waves rebounding off the structure during storms. The seawall itself may eventually be undermined.

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Devegetation of dunes can ultimately be as damaging as direct removal or withholding of sand. Vegetation is often removed from a large area when a construction site is cleared.

{Note that this implies that withholding of sand that would be otherwise available to build the dunes is as damaging as direct removal. This is EXACTLY what is happening in beach management at Port Aransas, where sand that was naturally being transported to the dune system to further build and grow the foredune ridge has been intercepted by front end loaders, graders and dump trucks and removed to be dumped on the lower beach where it is carried away by the waves and tides..}

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Vegetated and relatively stable dunes occur on Mustang Island and North Padre Island. On Matagorda and San Jose islands, where there is limited shorefront development, there is a continuous, well-defined foredune ridge averaging 15 to 20 feet above sea level. The most highly developed dune formations are found in Nueces and northern Kleberg counties, where there is a foredune ridge consisting of several rows of dunes that average 20 to 25 feet in height. Some dunes reach an elevation of 40 feet. Sandflats and areas of low coppice mounds are also characteristic of this region **(fig 9)**.