



THE GEOLOGIC STORY OF THE NATIONAL PARKS AND MONUMENTS

Fourth Edition

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COVER PHOTO:

Towering above Wrangell-St. Elias National Park, 18,008 feet above the Gulf of Alaska, Mt. St. Elias is one of the world's most inspiring sights. Russian Explorer Vitus Bering named the mountain in 1741, and because of its shape assumed it to be a volcanic cone. It was so regarded for a century and a half, until geologist I. C. Russell climbed its slopes and dispelled the myth. Mt. St. Elias is composed of rocks that were formed miles beneath the surface—rocks that were later thrust upward to more than three miles above sea level. Streams and then glaciers sculpted the pyramid that we see when looking northwest across the eastern edge of Malaspina Glacier, the largest piedmont glacier on the continent. Wrangell-St. Elias National Park and Preserve, set aside as a parkland in 1978, is now the largest unit—about 12.4 million acres—in our National Park System.

Photo by Charles G. Mull

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All color plates C1–32 can be found following text page 272.

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at present is that there is no consensus, except that the classical interpretation of Douglas Johnson of emergent shorelines is untenable. Papers by Fisher (1968), Hoyt (1970), Otvos (1970), Swift (1975), and others indicate that the problem is not being neglected. Possibilities that have been considered include the formation of coastal dune ridges that are later submerged; the development of complex *spits* on a shoreline of submergence; the emergence of offshore bars; and the shoreward migration of offshore bars. Whatever the theory on the mechanism or combination of processes, it must take into account the rise in sea level that resulted from the melting of Wisconsin glaciers, beginning about 11,000 years ago. Significant also are the changes that the barrier islands are undergoing at the present time.

Clearly they are the results of the work of the waves and the wind. All coasts are lashed periodically by storms, sometimes with hurricane force. The dune ridge superimposed on all barrier islands may be locally shifted landward; both the seaward and the landward beaches are likely to be eroded; in some cases the waves break through, forming new inlets or passes.

The Park Service had two objectives in mind when they established National Seashores such as Cape Cod, Cape Hatteras, and Padre Island. One purpose was to provide the public with additional recreation; the other was to preserve the beach areas in their natural state. It soon became apparent that their newly adopted areas were changing — in some cases drastically — with each violent storm. Their response was to initiate a program of stabilizing the dunes by building sand fences, and the shorelines by installing elaborate erosion-control structures. After spending large amounts of money, in certain cases without overwhelming success, the policy was re-examined. The Park Service had not attempted to thwart nature by trying to stop the erosion in Grand Canyon or in the Badlands. The decision was made in 1973 to let nature take its course, even with

this highly dynamic natural system (Dolan and Hayden, 1974). One bonus result from the new policy — it provides the opportunity for scientists to study natural processes at work, without any modifying influences by man.

PADRE ISLAND NATIONAL SEASHORE

The National Park Service broadened its coverage of natural environments by creating national seashores, beginning with Cape Hatteras in North Carolina in 1937. They now dot our shores, from Point Reyes near San Francisco to Cape Cod on the East Coast.

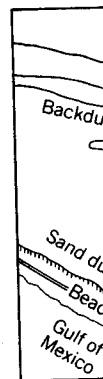
Padre Island National Seashore, established in 1962, occupies the 80-mile-long midsection of the 113-mile-long Padre Island near Corpus Christi, Texas. First called the White Islands because of its almost-white sands, this seashore was renamed around 1800 when Padre Nicolas Balli received a large Spanish land grant that included the island. Actually, Padre Island is a chain of elongate islands separated by narrow "passes" that were broken through during violent storms, only to be sealed shut by sand deposited by longshore currents. But new passes were broken through to once again connect the Gulf of Mexico with Laguna Madre, the long lagoon that lies between Padre Island and the Texas mainland.

The Intracoastal Waterway extends through the length of Laguna Madre; when the channel was dredged in 1949, the dredged material was piled up alongside. These spoil piles became island nesting sites for such waterbirds as the laughing gull, forsters tern, great blue heron, roseate spoonbill, and the white pelican. Because Laguna Madre is shallow and essentially cut off from the gulf, its waters have become increasingly saltier; according to Chief Naturalist Robert G. Whistler (personal communication, 1981) the salinity is at times almost twice that of gulf waters. Therefore only salt-tolerant plants such as shoalgrass can survive in the marshlands near the lagoon.



FIGURE 2C
Padre Island
across Pacific
Park Service

FIGURE 2C
Padre Island
showing :



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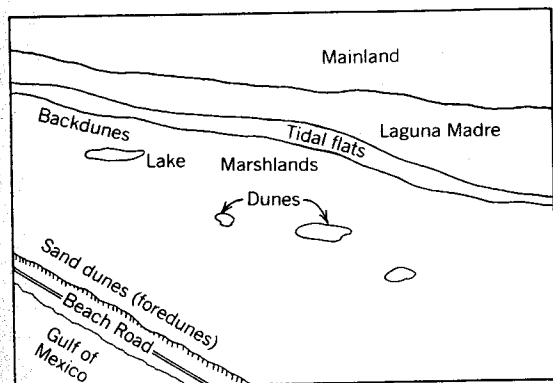


FIGURE 20-1a

Padre Island National Seashore: air view southwest across Padre Island. (Photo by R. Whistler, National Park Service.)

FIGURE 20-1b

Padre Island National Seashore: explanatory sketch showing zones and features.



Padre Island ranges in width from a few hundred yards to about three miles. The northern end of the seashore is sufficiently wide for the various geomorphic features to be clearly represented. High sand dunes, the foredunes, form a ridge that rises abruptly above the beach, as shown in Figure 20-1a. In the area beyond the foredunes there are many clusters of dunes, some temporarily stabilized by low-growing vegetation. Many of the interdunal areas are marshlands, but small lakes occupy some of the depressions. Farther west are

the back-island dunes, with the tidal flats and Laguna Madre beyond. The best way to see a representative section of the western part of the seashore is to take the Bird Island Basin Road, which leads west a short distance north of the ranger station.

Your first stop should be the visitor center where you can obtain valuable information, including warnings of hazards such as the Portuguese man-of-war jellyfish, stingrays, rattlesnakes, and unexploded ammunition (relics of the days when the U. S. Navy used parts of the island as target sites). Next, get an overview of the island from the observation tower on Malaquite Beach. With binoculars, you can see all of the features mentioned above.

Origin and Development of Padre Island

Padre Island is young, less than 5000 years old (Fisk, 1959). Several mechanisms have been proposed for the origin of barrier islands but no one explanation appears to be satisfactory for all of the world's offshore islands.

For Padre Island, Weise and White (1980) favor the offshore bar origin. They picture a sandbar, a ridge of sand piled up by the waves, in shallow water near shore. With continued wave action the bar is built up above sea level, thus forming the embryonic island that will be widened and heightened by subsequent wave and wind action. But problems arise when we examine this sequence carefully. Anything exposed to the lashing of the waves will be destroyed in time; a low ridge of loose sand would not withstand the onslaught of even one of the hurricanes that occur here every few years. Also, it is significant to note that, although there are submerged bars offshore now, at no point have they been built up to the surface.

Others workers visualize an entirely different sequence. Frank Ethridge (personal communication, 1981) begins the sequence with a long, high ridge of sand bordering the mainland coast — coastal dunes like those found in

many places today. Sea level has been rising since the great glaciers began to melt back some 11,000 years ago; eventually the waters of the gulf invaded the area back of the dune ridge, thus forming Laguna Madre and isolating Padre Island from the mainland. Hoyt (1967) and others agree that this explanation is the logical one for the origin of Padre Island, at the same time recognizing that other barrier islands may have been formed in other ways.

As is true of all barrier islands, Padre Island is being reshaped. During heavy storms, the waves erode the sand away from the beach side of the foredunes, thus shifting the beach-dune boundary westward and enlarging the beach area. From time to time, hurricane-driven water overwashes the dunes in places and forms new passes through the ridge. The floodwaters rush across the island and deposit sand as washover fans where the water spreads out over the tidal flats, even out in the lagoon. Thus, the island is being extended westward at the expense of Laguna Madre.

On the gulf side of the island, the wind picks up the sand from the beach and carries it up onto the ridge, where much of it is deposited. Some, however, is carried far beyond the ridge and is deposited on the flats, where it is shaped into dunes. Until the dunes are stabilized, they are moved about by the wind, as "wandering" dunes. The back-island dunes form a low, irregular ridge along the east side of Laguna Madre. In many places the dunes are at least partially stabilized by grasses, low-growing shrubs, and by the long railroad vine. In the interdunal areas, grasses thrive in most places, providing good grazing for cattle prior to the time that the national seashore was established. Live oak trees, once fairly widespread, are almost entirely gone, having succumbed to droughts and to burning by the ranchers — to improve the grass.

When fierce winds blow, the least stabilized sand is carried away, forming "blowouts," bowl-shaped "wounds" on the windward side of the dunes. Once the deflation process

starts, it is likely to continue for some considerable period, sometimes enlarging the blowout to enormous size. A blowout that will probably be there for years is along the Grassland Nature Trail in the northern section of the seashore. An hour or two on this nature trail is time well spent, assuming that you keep a sharp eye out for rattlesnakes.

The *Padre Island Field Guide* by Hunter et al (1972) contains a road log and other information that will help you make the best possible use of your time. The Malaquite Beach section is off-limits for all vehicles. Most of the roads are travelable by road car, but a 4-wheel-drive vehicle is a must if you want to go far to the south, with stops on Little Shell and Big Shell beaches along the way. You will be well rewarded if you spend two or three hours on the beach near the northern end of the Seashore, at the end of the North Beach Access Road. To the south of the parking area, the beach is for walking only; as a result, burrowing animals such as the ghost crabs, mole crabs, and ghost shrimps have the opportunity to live their lives without being disturbed by cars, trucks, and motorcycles. If you are there at the right time, you will see the beautiful blue Portuguese man-of-war jellyfish. *Do not touch*; if you get stung, *do not rub*! Go immediately to the nearest first-aid station for treatment.

Padre Island attracts birds of many kinds, especially during the winter. One big bird that probably will not be there is the whooping crane. To see it, you will have to go to Aransas National Wildlife Refuge about 50 miles (83 km) north of Corpus Christi. To see these big fellows "gal-loping" low over the water is an experience to long remember.

The animals on and around Padre Island include the coyote, jackrabbit, the Mexican freetail bat, several kinds of rodents, a few Ridley sea turtles, lizards, and snakes. There are also fish in the Gulf and in Laguna Madre. There are many fascinating things to see at Padre Island; surely some of them will be of sufficient interest to distract you from swim-

ming and fishing, at least for part of the time. Padre Island is open throughout the year; winters are delightful except when a "norther" moves in to chill the air.

Most barrier islands are "graveyards for ships." Since hurricanes are a common occurrence, Padre Island has had its share of shipwrecks. Long ago, when the island was the home of cannibalistic Indians, the hazard was much greater. Of the many who were "fortunate" in surviving the storm in 1533, when a Spanish fleet ran aground, only two escaped from the Indians.

EVERGLADES NATIONAL PARK

At the southern tip of Florida, where the waters of the Gulf of Mexico meet those of the Atlantic, is a vast, flat lowland known as the Everglades. Large areas are covered by shallow water—in lakes, freshwater sloughs, estuaries and bays. This aquatic, subtropical environment of sawgrass and mangrove trees is alive with crocodiles, alligators, manatees, roseate spoonbills, anhingas, wood storks, and a host of more common animals and birds. It was for the purpose of preserving this unique environment that about 1,400,000 acres of land and water were established as Everglades National Park in 1947.

The park extends westward from Homestead, where the park headquarters are located, to Everglades on the Gulf of Mexico. On the west side the park extends out into the Gulf and includes the Ten Thousand Islands; on the south it extends across Florida Bay almost to the Florida Keys. Highway 27 leads west from Homestead and then south to Flamingo at the southern tip, with stub roads to Royal Palm, Pa-hay-okee Overlook, Mahogany Hammock and other points of interest.

The land that is now the Everglades was beneath the sea until recent geologic time. Now, after being above the sea for a short period, the Everglades are gradually losing ground (Glea-

son, 1972). Although the boundaries of the park remain constant, the land area is gradually shrinking.

The geology of Everglades National Park is relatively simple. Along the western side, limestones of the Miocene Tamiami Formation lie beneath the swamps and bogs (Gleason, 1972). Apparently no Pliocene sediments were laid down in this area. Most of the park is underlain by the Pleistocene Miami Oolite, or oolitic limestone, composed largely of tiny, spherical concretions that resemble fish roe.

The oolite is porous and permeable, and the surface layers are unusually susceptible to chemical weathering. Consequently, the surface is in many places pitted and irregular. On this surface, peat accumulation has been rapid because of the luxuriant vegetation—mangrove trees, water-lilies, and sawgrass. Perhaps this is a present-day coal-forming swamp.

If we probe deeply into the past, we find that beneath the surface rocks are Paleozoic metamorphic rocks similar to those exposed

FIGURE 20-2

Everglades National Park headquarters, from along Anhinga Trail.

