

A west wind pushes the sand, piling it higher and higher. Then, like an ocean wave, the crest collapses. An east wind shoves back, reshaping the mound. This is the ongoing dance across the 30 square miles (78 square kilometers) of land that is the Great Sand Dunes of Colorado. They are the largest sand dunes in North America. The tallest among them is 750 feet tall (230 meters). The sand was left here, in the valley between the San Juan mountains and Sangre de Cristo mountains, hundreds of thousands of years ago by receding alpine lakes. Today, mountain creeks that cradle the dunes carry sand down to the sandsheet at the Great Sand Dunes' edge. From the sandsheet, the wind blows the sand back into the sand dune lands.



Wind and water shape the dunes of Great Sand Dunes National Park and Preserve in Colorado. In some areas, vegetation also plays a role by holding the sand in place.

As with any sand dune **ecosystem**, the key **abiotic factors** that continually reshape the Great Sand Dunes are wind, water, and sand. Additionally, in some areas plant roots trap sand which helps stabilize the dunes.

There is a complex web of interconnections among abiotic and **biotic factors** of a sand dune ecosystem. The **species** that live there must tolerate strong winds and, in some inland sand dunes, harsh temperatures. At the Great Sand Dunes, on a summer's day, the surface of the sand can reach 150 F (65°C); on a winter's night, the temperature can plummet to 20°F (29°C). Another special feature of the Great Sand Dunes is that under the dry top layer, the sand is relatively moist.

The species that are adapted to and depend on the abiotic factors of the sand dune ecosystem are themselves important biotic factors. In the Great Sand Dunes, the scurfpea plant provides shade for some insects, and its small purple flowers feed insect pollinators. Indian ricegrass, which grows particularly well in sand, supplies seeds for the Ord's kangaroo

rat. It stuffs its cheek pouches full with seeds and carries them into its underground burrow where it buries the seeds in the moist sand. Over time the seeds absorb moisture, which is the kangaroo rat's only intake of water.

Another species that is specialized for life on the sand dunes is the tiger beetle. In fact, the Great Sand Dunes tiger beetle is one of at least seven insect species native to these dunes and not found anywhere else on Earth.

Sand dune ecosystems can be found around the world. Of particular significance are coastal sand dunes, which protect both natural grasslands and built structures from storm surges and tsunamis.

Wind, ocean waves, and inland rivers transport sand to the beach. Winds and waves then shape the sand into a row of primary dunes next to the beach. A row of secondary dunes forms farther inland. The organisms here must be able to withstand strong winds, very little fresh water, sand abrasion, and, especially in the primary dunes, salt spray and waves. Yet many plants thrive here such as native dune grass, seashore lupine, and kinnikinnick. Various bird species, garter snakes, shrews, spiders, and beetles make up some of the **populations of animals**.

Unfortunately, the coastal sand dune ecosystem is extremely vulnerable to changes in abiotic and biotic factors. Just trampling across the native dune grass damages it. And without the grass roots and stems to help trap sand, the sand blows right off of the dunes. In addition, when people build structures such as sea walls too close to the dunes, the natural build up and erosion of the sand dunes cannot occur.



Padre Island off the Gulf coast of Texas is lined with sand dunes. The sand dunes protect the island grasslands from storm surges.

Nesting birds and sea turtles are among the wildlife that depends on sand dune ecosystems. Some of these animals are threatened or endangered, and changes to their habitats can reduce their populations even further. Sea turtles, for example, lay their eggs in or near the sand dunes. After the turtles hatch, the egg shells act as fertilizer for sand dune vegetation. Also, these animals are important biotic factors in their own environments.

### Comprehension Questions

1. How effective was the writer at evoking a sense of place? Use specific examples to justify your response.
2. Why is it important not to disturb or trample on sand dune vegetation?
3. Which is more important in a sand dune ecosystem: biotic or abiotic factors? Justify your response.



This is a baby loggerhead sea turtle. Sea turtles lay their eggs in or near coastal sand dunes, which contributes valuable nutrients to the sand dune vegetation.