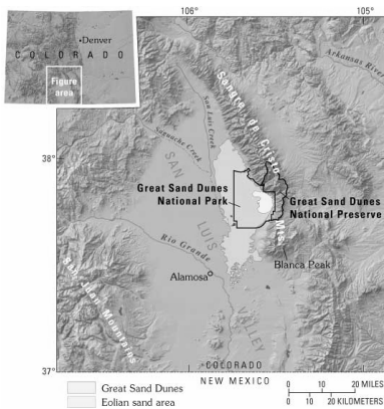


Structural Forces What Holds the Water?

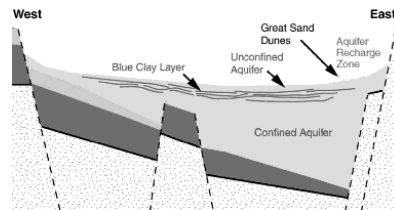
- ⌘ Laramide Orogeny 65-22 million yrs ago.
- ⌘ Erosion begins following the Laramide orogeny.
- ⌘ Compression shifts and 500 mile long Rio Grande Rift forms. (upper Arkansas Valley to west Texas creating huge grabens where San Luis Valley now occurs)
- ⌘ Volcanic activity.
- ⌘ Thermal Plume under rifts main axis create hot springs along its eastern and western lines.



Structural Forces What Holds the Water?

- ⌘ 5 mya 5,000' of uplift.
- ⌘ Precambrian faults and Laramide faults are reactivated.
- ⌘ Fourteeners are built.
- ⌘ Graben valley are redefined and increased precipitation form 30,000 feet of sediments (sand, clay, lava flows and rock debris deposited in the valley and equals the height of Mt Everest)
- ⌘ Pleistocene Ice Ages and violent sandstorms form the glaciated valleys and Great Sand Dunes National Park.
- ⌘ Water now continues to fill the aquifers.

San Luis Valley Aquifer System



- ⌘ Contains 2 billion acre-feet of water (50x the combined capacity of Lake Powell and Lake Mead).
- ⌘ Rivers flowing west and east annually recharge the aquifer.
- ⌘ Unconfined (200') vs. confined aquifers (5-30,000' and 30,000 year old water.)

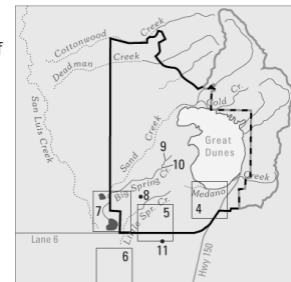
Hydrology as the Basis for Biodiversity

- ⌘ Northern aquifer is a 2,900 sq. mile closed basin. (includes GSDNP and =35% of valley) Water enters via a network of natural underground conduits, and finally reach a low point at the San Luis Lakes.



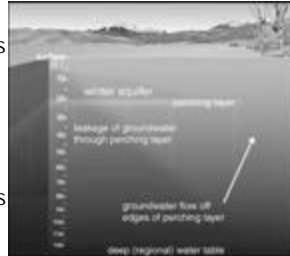
Hydrology as the Basis for Biodiversity

- ⌘ Medano and Sand Creek maintain the existence of the Great Sand Dunes. (capillary action from unconfined aquifer meet and create the "glue" holding the dune system in place).
- ⌘ > 60 years for water to immerge in the form of springs or interdunal wetlands.



San Luis Valley Aquifer System

- Water flows across "hardpan" or caliches (Calcium Carb) in summer.
- Aquifer sinks in Winter and surface flow disappears.
- Unconfined Aquifer is 120 feet below the surface.



Hydrology as the Basis for Biodiversity



Hydrology as the Basis for Biodiversity

- Western edge of dunes the wind scours depressions deep enough to tap an artesian spring, interdunal wetlands form. (40 in 1959, now only a few remain)



Hydrology as the Basis for Biodiversity

- Playas in the upwind sand dune margins (ephemeral saline lakes)
- Pleistocene playas once supported the now-extinct buffalofish, and brine shrimp

Hydrology as the Basis for Biodiversity

- Today these playas, and interdunal wetlands, which were more extensive in the Pleistocene provide habitat for shorebirds, Sand Hill Crane, Ibis, ducks, and many other species.
- Spring/Fall Migration



Hydrology as the Basis for Biodiversity-Birds

- Wilson's Phalarope-spin 60 revs/min to catch aquatic inverts. Winter in South America.
- Black Tern catch aquatic inverts on the wing.



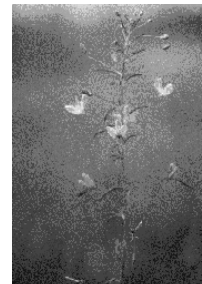
Hydrology as the Basis for Biodiversity-Birds

- ☞ Snowy Plovers- Threatened do to habitat loss.
- ☞ Nest in only a few inland areas including the San Luis Valley.
- ☞ Migrate to coastal regions in winter.



Hydrology as the Basis for Biodiversity-Plants

- ☞ Slender Spiderflower- *Cleome multicaulis*
- ☞ Annual and endangered wetland species.
- ☞ Disappeared from 90% of former range.
- ☞ Loss of alkali wetlands it prefers do to grazing animals.



Water and Homo Sapiens

- ☞ Date back to Folsom culture-10,900 - 10,200 years ago
- ☞ Much more precipitation, hung out along the closed basin.
- ☞ 1598 Spanish conquest
- ☞ 1848 American Territory.

Water and Homo Sapiens Modern Water Use

- ☞ Closed basin provides irrigation water source.
- ☞ > 2000 ¼ mile circles of potatoes, barley, lettuce and alfalfa
- ☞ 1939 Rio Grande Compact- 42 miles of channels remove 40,000 acre feet annually from unconfined aquifer to the Rio Grande River for New Mexico and Texas water use.



Water and Homo Sapiens Modern Water Use

- ☞ AWDI-American Water Development, Inc. 1980's-1990's proposed to export water from beneath Baca Ranch and sell it to the highest bidder for urban use in LA and AZ
- ☞ NPS and public alliance fought back and won.
- ☞ Research began.

Water and Homo Sapiens Modern Water Use

- ☞ 1995 Stockman's Water, and Ken Salazar spoke with a new law that once again won the battle.
- ☞ 1999-Nature Conservancy purchased the 100,00 acre Medano-Zapata Ranch now Closed Basin hydrological system are permanently preserved.
- ☞ 2004 Great Sand Dunes National Park.