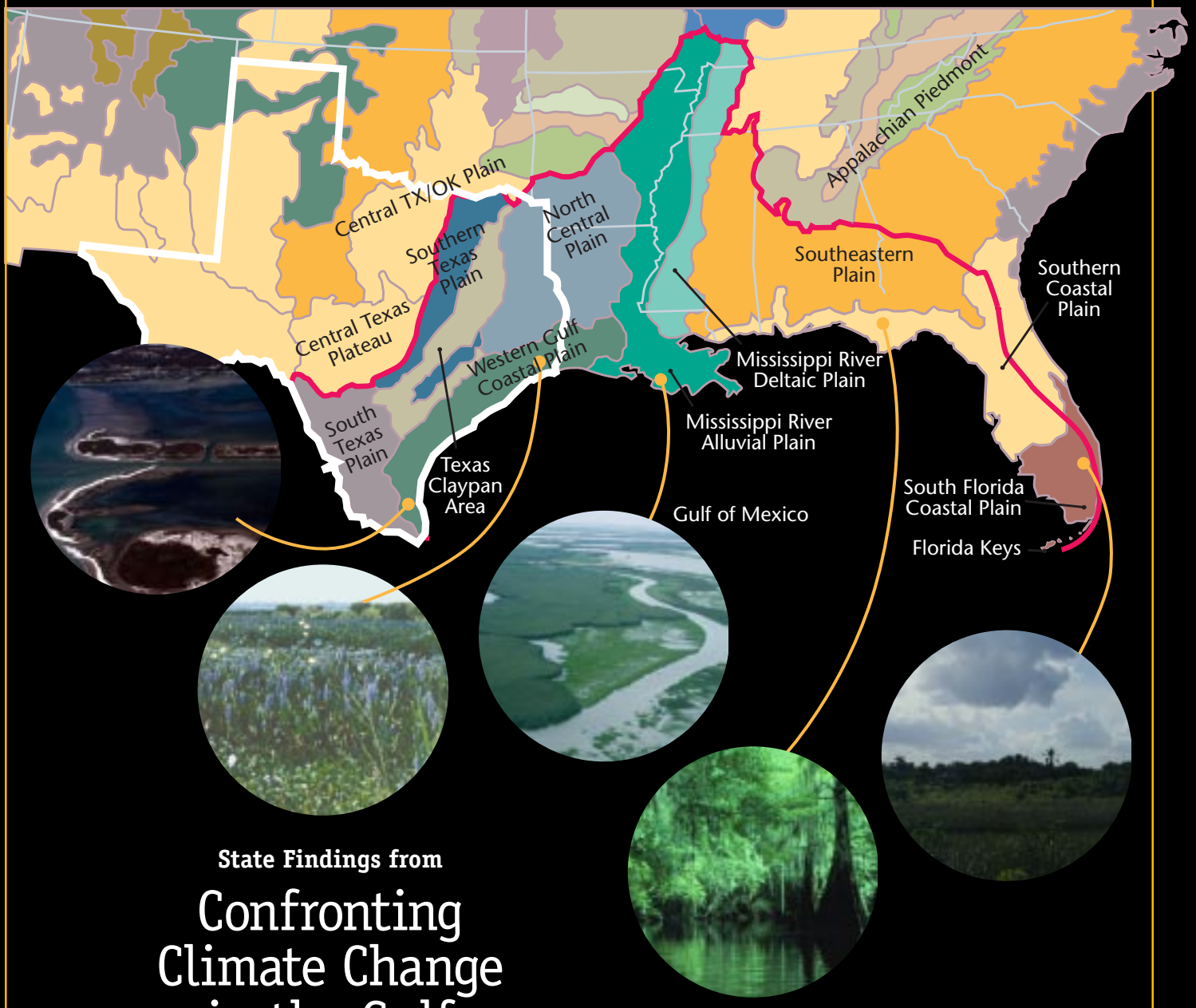
Texas



State Findings from

Confronting Climate Change in the Gulf Coast Region

Prospects for Sustaining Our Ecological Heritage

Texas's Variable and Changing Climate

Texas's climate has always been variable and sometimes extreme—and climate change may intensify this historical pattern. Average state temperatures have varied substantially over the past century, with a warming trend since the late 1960s. Average rainfall has increased slightly, both in the summer and winter, and extreme rainfall events have become more frequent. For example, 20 inches of rain fell in 24 hours in San Antonio in October 1999. In the winter, radical temperature variations can occur with the passage of cold fronts, so-called Northers, with drops of 30–40°F within hours.

The western Gulf of Mexico has a subtropical and mostly semi-arid climate, with annual rainfall ranging from as little as seven inches at the Rio Grande to over 40 inches at the Louisiana border. Besides geographic differences, Texas also experiences substantial variation in climate from season to season and year to year. Persistent southeast winds off the Gulf dry out the landscape. While thunderstorms and tropical storms can bring respite from the dry summers, they can result in substantial flooding to the region as well. Tropical storms strike the Texas coast on average once every seven years. In addition, sea level from Brownsville to Port Arthur has risen steadily, increasing eight inches over the past 100 years. However, the rate of sea-level rise varies locally with the rate of land subsidence.

Future Climate Projections for Texas

It is possible to assess Texas's vulnerability to a rapidly changing climate, even though extracting state-specific information from global climate model projections entails significant uncertainty. Therefore, scientists use a variety of models and other scientific methods to project plausible climate futures as a basis for impact studies. For the US Southeast, the climate projections from the best available climate models agree on temperature and sea-level increases, but differ on changes in precipitation in some parts of the region. Because future trends in rainfall and runoff are critical to human and ecological well-being in the Gulf Coast region, the most prudent approach is to assess the potential impacts of both the drier and wetter scenario. The following climate projections are derived from models produced by the Canadian Climate Centre and the U.K.'s Hadley Centre.

- *Temperature*: Maximum summer temperatures could increase by 3–7°F—with rises in the July heat index of 10–25°F; minimum winter temperatures could increase by less than 3° to about 10°F. The freeze line is likely to move north.
- *Precipitation and runoff*: Rainfall and summer soil moisture is likely to increase in the immediate coastal regions of Texas, except for a portion of the south Texas coast. In upland areas, one model projects wetter weather; the other, drier. Where drought conditions increase, so does the risk of wildfires.
- *Sea-level rise*: Sea level will increase at a faster rate over the coming century. At a continued average rate of subsidence of four inches per century, a mid-range sea-level rise figure would result in ocean levels 17 inches higher by 2100.
- *Tropical storms*: Hurricane intensity (maximum wind speeds, rainfall totals) could increase slightly with global warming, although changes in future hurricane frequency are uncertain. Even if storm frequencies and intensities remain constant, however, the damages from coastal flooding and erosion will increase as sea level rises.

Potential Impacts from Global Warming on the Environment, Economy and Public Services of the Lone Star State

Freshwater Resources

Fresh water is critical for the state's nearly 21 million residents—85% of whom live in cities. As the state's population grows to a projected 34 million by 2030, agriculture, fisheries, and industry will continue to require

> Competing demands on limited water resources due to population and economic growth alone will increase freshwater management challenges with or without climate change.

Susanne Moser

Sea-level rise will increase storm surges, even if hurricanes and tropical storms do not become more intense.

Thomas Minello, National Marine Fisheries Service

reliable freshwater resources to remain productive. Competing demands on limited water resources due to population and economic growth alone will increase freshwater management challenges with or without climate change.

- Saltwater intrusion in coastal groundwater sources—a problem already occurring periodically during droughts—is likely to increase as sea level rises. Rationing of groundwater withdrawal may become more common.
- Higher water temperatures are likely to reduce water quality for freshwater ecosystems and species.
- Severe water resource management challenges could result in areas and during times when changes in rainfall, evaporation, groundwater recharge rates, and runoff patterns combine to decrease water availability. On the other hand, where water availability due to global warming increases, the growing competition for water may be somewhat alleviated.

Human Health

Health concerns related to global warming result from a complex interaction of human and environmental factors. They are particularly serious for the elderly, but air and water quality, seafood safety and storm-related risks are of great concern for all residents and visitors.

- The greatest increase in the July heat index is projected for the southern United States. Texas—especially Dallas, Houston, and other major metropolitan areas—is particularly vulnerable to more heat waves.
- Texas is likely to see an increase in the number of heat-related illnesses and deaths, especially among the elderly, very young, those whose health is already compromised, and the very poor who are unable to protect themselves from the heat. The current average number of heat-related deaths in Dallas and Houston of 28/year could more than double to 60-75 with a 3°F increase in average summer temperatures.
- Higher temperatures also lead to increased production of ground-level ozone and smog, exacerbating asthma and other respiratory diseases and making it even harder for urban areas such as Houston-Galveston to attain federal air quality standards.
- The risk of water-borne illnesses can increase with warmer temperatures and extreme rainfall and runoff. The actual incidence of gastrointestinal diseases, respiratory diseases, and skin, ear, and eye infections, however, is determined only in combination with human factors—such as the effectiveness of water and sewage treatment and the responsiveness of the public health system. Thus, climate-related health risks will place greater demands on public health resources.
- Vulnerability to climate change and water-related health risks is particularly severe in areas where water supply and quality, waste disposal systems, and power supplies for heating and cooling are already substandard.
- Microorganisms associated with diseases in coastal waters—such as toxic algae, red-tide dinoflagellates, *Vibrio vulnificus* (a pathogen contaminating shellfish), and others can damage habitat and shellfish nurseries and be toxic to both marine species and humans.

Coastal Development and Infrastructure

Although a significant amount of the state's tidal coastline is protected and undeveloped, the unprotected areas have been rapidly developed in the last 20 years as residential, recreational, tourism sites. Other areas, such as Galveston Bay and the international seaport of Houston, have long been critically important industrial sites and transportation hubs. As development and economic activity in coastal areas has increased, so has societal vulnerability to coastal hazards.

- Sea-level rise will increase the rates of erosion—an already significant threat to homes, roads, and other infrastructure along the shorefront.
- Sea-level rise will also increase storm surges, even if hurricanes and tropical storms do not become more intense. Thus, greater economic losses from storms and higher repair

and maintenance costs (e.g., for maintenance of port and industrial facilities or beach replenishment) must be expected in the future.

Fishing industry

In the bays and estuaries behind the barrier islands separating the Texas mainland from the Gulf of Mexico, fresh and saltwater combine to create the environment that shrimp and oysters need to live and flourish. The state's aquaculture industry—11th in the nation in producing food fish, baitfish, ornamental fish, shrimp, crawfish and oysters—is particularly sensitive to adequate amounts of freshwater and increases in salinity.

- If freshwater flow into lagoons and bays permanently declines, then higher salt concentrations, less nutrient input, and less frequent flushing result in lower water quality overall. Salt tolerance of some species may be exceeded, causing changes in the food web and possibly a reduction in fish productivity.
- If freshwater inflow increases, the oxygen-poor "dead zone" (hypoxia) off the Texas coast may expand. Shrimp yield would decline as a result.

Gwenn Hansen

Agriculture and Forestry

Agriculture and forestry are both enormously important industries in Texas and highly sensitive to climate change.

- For South Texas, climate models project drier conditions in the immediate coastal zone. As a result, the risk of wild fires would increase, which in turn would help maintain coastal prairies and grazing lands by suppressing the permanent establishment of invasive species such as Chinese tallow.
- The production of cotton, currently ranked first in production value in the nation—may decline without irrigation. Other crops, such as soybeans, sorghum, hay, vegetables, and citrus fruits could be similarly affected without irrigation. (*Note:* The fertilization effect from elevated levels of CO_2 will only increase productivity with sufficient irrigation.) Rice production in coastal areas would be particularly sensitive to an increase in water salinity.
- The managed shortleaf and loblolly pine tree forests in eastern Texas contributed $12.3 billion to the state economy in 1997. They are vulnerable to drought and fire in areas that could become drier. As temperatures rise, the capacity of trees to absorb and store carbon decreases.
- Savannas and grasslands would expand at the expense of forests, particularly in the uplands of the Gulf Coast if the drier climate scenario were to play out.
- Increased fire frequency in drier conditions would require significant adaptations in forest and fire management (species selection, stand density control, fertilization, rotation length changes). Extreme, long-lasting droughts would seriously damage forests in the long-term.
- Warmer, wetter conditions increase the risk of agricultural and forestry pests such as Southern pine bark beetle.

Tourism and Recreation

Global warming can affect tourism and recreation in multiple and often synergistic ways.

- Wetland loss due to increased rates of sea-level rise and limited ability of wetlands to migrate inland could reduce habitat for waterfowl and other wildlife essential to hunting and recreational fishing.
- Rising sea levels will increase coastal erosion, leading to beach loss where sediment supplies are low, and to increased risk of damages from severe coastal storms.
- Bird watching, canoeing, and other outdoor activities may be affected by higher temperatures and/or wildfires or through changes in species communities or loss of habitat, thus undermining the ecotourism industry.
- Many natural habitats in the Texas coastal region harbor threatened or endangered species—the whooping cranes of Aransas, the sea turtles of Laguna Madre, or the richly diverse Big Thicket. Habitat losses due to continued human development combined with climate change impacts could increase the threats to these species.

Union of Concerned Scientists

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This fact sheet is based on the findings of *Confronting Climate Change in the Gulf Coast Region*, a report published in October 2001 by the Union of Concerned Scientists and the Ecological Society of America. The report was written by 10 regional experts under the leadership of Robert Twilley (University of Louisiana-Lafayette). Experts from Texas included Roger Zimmerman (National Marine Fisheries Service, NOAA-Galveston) and Evan Siemann (Rice University).

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The full report is available from UCS at www.ucsusa.org or call (617) 547-5552.