ON THE MOVE: Texas Fish and Game in a Changing Climate

BY WENDY GORDON, PH.D.

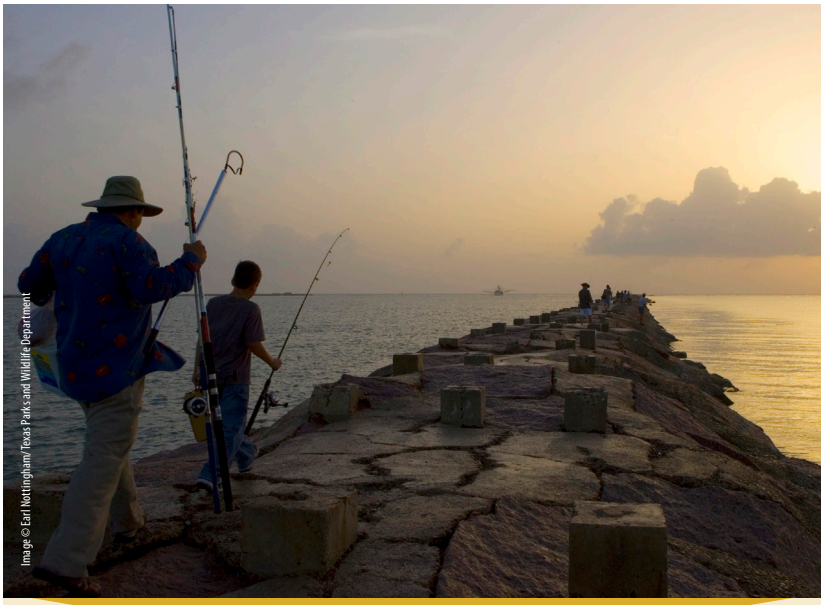
As a sportsman or woman, you know that the animals you prize for hunting and fishing are highly attuned to climate. In fact, climate is the key factor determining where species live. Temperature and moisture influence when plants leaf out, when insects hatch, when and where birds migrate and nest, when rutting season begins, and how many offspring are successfully reared. If you have spent decades enjoying the Texas outdoors or know someone who has, you are probably aware that the landscape is changing. Almost everyone has a story of catching a saltwater fish off a favorite pier where it had never been seen before or of finding it more difficult to hunt geese in Texas because they are not as plentiful as they once were.

Many of the changes being observed across land and water habitats — changes in the types of fish, wildlife and plants, their population size, and shifts in where and when species are found — are signs of climate change. Climate change sums up a lot of different phenomena currently under way, from warmer winters to more severe flooding rains to longer periods of drought and warmer inland and coastal waters.

Texas has a rich natural heritage, which raises the stakes for risks from climate change. We do not know exactly how climate change is going to affect every species, but "winners" and "losers" are already emerging. As the Earth warms, species tend to shift to northern latitudes and higher altitudes as those areas offer more accommodating habitat conditions.

Birds are among the most mobile species on Earth, and changes in their habitats and habits are already appearing. Biologists have been tracking the northward expansion of white-winged doves for decades. Originally confined to the Lower Rio Grande Valley, by 2001 they were found as far north as Kansas. The U.S. breeding ground of another species, the migratory black-bellied whistling duck, had extended only as far north as Texas in the early 1990s, but more recently its breeding range has edged further north to include Oklahoma, Louisiana and Arkansas.

Probably the greatest observed change has been in the wintering ground of snow geese. The Texas population of these birds tripled between about 1995 and 2005, and it was common knowledge that the Texas coastal prairie offered the nation's best goose hunting. Since then, milder winter conditions to the north have shifted the bulk of the wintering snow goose population to Arkansas, which now boasts almost nine times as many geese as Texas. Some snow geese overwinter even farther north in Kansas, Nebraska and Missouri. Fifteen years ago, Texas supported more than a million birds, but in 2014, fewer than 200,000 found their way to the state, a record low.



The fish of Texas' bays and estuaries are also feeling the effects of climate change. Texas bay waters have warmed by an average of nearly 3°F over the past 25 years, mostly caused by warmer winters. Before 1993, winter temperatures routinely fell below the level that caused die-offs of gray snapper, limiting its range to the lower Laguna Madre and off the extreme southern shore of Texas. Since then, shorter and less severe freezes, and the resulting warmer surface water temperatures, have improved juvenile survival and allowed this species to migrate all the way up the coast to Sabine Lake near Port Arthur, where they are now so common that some anglers specifically target them. Fat snook, common snook, and tarpon, all fish that favor warmer water and cannot tolerate water temperatures below 50°F, have also expanded their range northward into the upper coast bays, and Atlantic croaker is benefitting from milder winter conditions throughout their range, including in the Gulf of Mexico. On the other hand, southern flounder, which are at their southern limit off the Texas coast, are struggling as water temperatures rise.

Plant communities along the coast also are affected by warmer winter conditions, and in turn they impact fish and wildlife. We are already witnessing changes as cold-sensitive plant species such as the red mangrove move north up the Texas coast. Maps from 2000 showed no red mangrove north of the Rio Grande estuary; today they are appearing as far north as the edge of Matagorda Bay. A related species, the black mangrove, is a small shrubby tree that grows in salty sediments along the coast. Over a 20-year period starting in 1990, it has expanded its range along the Texas Gulf Coast by 74% and is out-competing native saltmarsh species as the intervals between winters with freezing temperatures lengthen — and as sea level rises.

All along the Texas coast, sea level is rising from a combination of factors. Globally, warming ocean temperatures cause water to expand, and water is also being added to the ocean from the melting of polar sea ice, ice sheets and glaciers. Locally, many places on the Texas coast are experiencing subsidence, the gradual sinking of the land, which causes the water to rise relative to our location on the shore.

Rising sea levels cause frequent and longer flooding of salt marshes, some of which have now become tidal flats or open water. Seagrass beds are appearing and disappearing with changing water depths. Tidal flats are spreading inland. Coastal plains ecosystems may be threatened by saltwater intrusion. All of these different types of ecological communities are important habitat for fish and wildlife, but little is known about the effects on these species from the transformation, for example, of a grass-dominated salt marsh into a wood-dominated mangrove forest.

Why the relatively recent focus on climate change? After all, throughout Earth's history, our planet's climate — that is, characteristics of weather averaged over at least 30 years — has swung between ice ages and extended warming periods. However, the current pace of warming is happening faster than ever before. In some cases, such rapid warming may be beyond the ability of plants and animals to adapt. U.S. average temperature has increased about 1.5°F since 1900, and globally, 20 of the warmest years since 1880 have occurred since 1981. The past 12 years have included the 10 warmest years on Earth since we began measuring the temperature, even though there was a decline in solar output. We're seeing the effects of warming in a variety of other measurements: Oceans are warming, ice is melting at the poles and glaciers, and sea level has risen almost 7 inches in the past 100 years.

Changes in rainfall patterns are also making news. Warmer air can hold more water than cooler air, so higher temperatures can mean heavier and more frequent storms. Average U.S. rainfall has been

increasing, and the heaviest rainfall events have become heavier and more frequent. At the opposite end of the spectrum, during periods of drought, higher temperatures will amplify their intensity. In Texas, where our climate alternates between the extremes of flood and drought, the amount of rain that has fallen in the heaviest precipitation events has increased by about 15% since 1958. At the same time, in the past several decades, soil moisture has declined in Texas as droughts have increased. The summer of 2011 was both the warmest on record and driest on record in Texas since 1895.

As an avid Texas hunter or angler, what does all this mean for you? In the lifetime of a child born today, we expect an acceleration of the changes already being seen — from extensive warming to shifting patterns of precipitation, sea level rise, changes in the timing and length of the seasons, and increasing frequency and intensity of severe weather events. While the Earth has experienced warming periods in the past, the current pace of warming is happening faster than ever before. In some cases, such rapid warming may be beyond the ability of plants and animals to adapt.

Another foot and a half of sea level rise this century along the Texas Gulf Coast will inundate coastal wetlands and adversely affect many species of fish that rely on those wetlands for spawning. Warmer water in lakes, wetlands and rivers may lead to the spread of nuisance species, particularly tropical aquatic plants that clog waterways and drive out fish. Higher water temperatures will also likely result in lower dissolved oxygen, which could mean more fish kills and more frequent blooms of harmful algae such as golden alga and red tide.

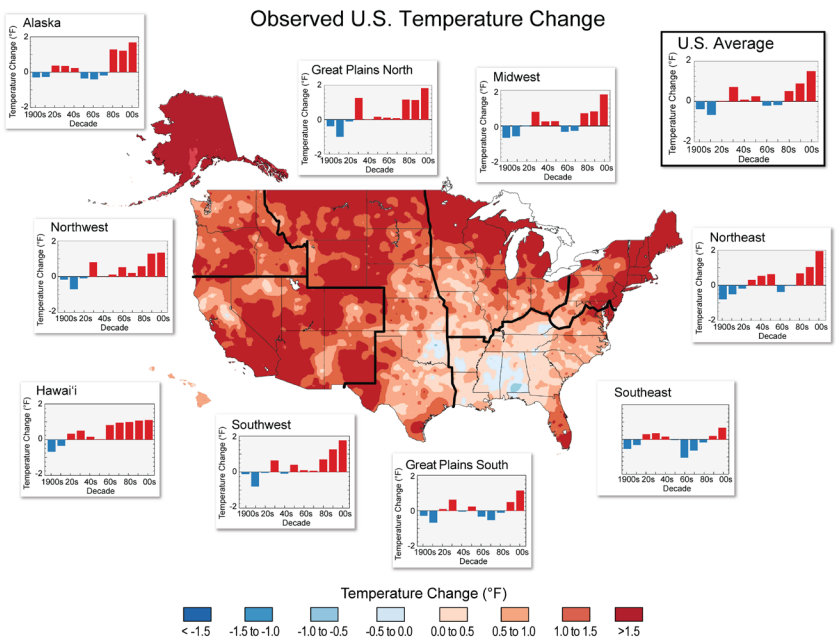


Figure 1. Observed U.S. temperature change from 1991-2012 compared to the 1901-1960 average (1951-1980 for Alaska and Hawai'i) in degrees Fahrenheit. Bars on the graphs show average temperature changes by decade relative to the long-term average for each region. The far right bar in each graph (2000s) includes 2011 and 2012. The period from 2001 to 2012 was warmer than any other decade in every region. (Figure source: NOAA NCDC / CICS-NC)

In Other States

During the drought and heat waves of 2012, at least 15 states reported outbreaks of hemorrhagic disease in deer populations. Minnesota has closed down moose hunting because of abnormally high mortality from parasites such as ticks, nutritional deficiencies, and heat stress as summer temperatures have soared.

DURING DROUGHT AND HEAT WAVES

15

STATES REPORTED HEMORRHAGIC DISEASE OUTBREAKS

EXTREME HEAT KILED

1,700

WALLEYE IN KANSAS' CHENEY RESERVOIR

Extreme heat is a concern for fish requiring cold waters, such as trout and salmon, but even warmer-water species are susceptible when water temperatures rise above key biological thresholds. For example, more than 1,700 walleye in Kansas' Cheney Reservoir were killed in 2011 when water temperatures exceeded 80°F in late August.

Nationally, we are already experiencing more intense and longer fire seasons, and the more frequent and intense wildfires cause direct mortality of game and destroy habitat. Increased heat and drought in Texas may also mean that playa lakes serving as refuges for migrating waterbirds will dry up. Extremes of drought and flooding may disrupt quail nesting. Hot, dry summers expose big game species such as white-tailed deer to parasites and diseases that thrive under those conditions, as well as nutritional deficiencies and heat stress, which has already been seen with devastating consequences in more than a dozen other states.

What is your role? Now that you are more informed about climate change and its consequences, pledge to stay informed. As someone who enjoys the outdoors, you can help all of us better understand how climate change is altering the landscape and affecting species by sharing your stories with resource agencies and participating in the management and policy conversations that will shape our future. Collectively, our actions will determine the condition of the planet our children and grandchildren inherit.

You can learn more about climate change at the links below:

http://climate.nasa.gov/
http://www.globalchange.gov/
http://www.noaa.gov/climate
https://nccwsc.usgs.gov/
https://www.fws.gov/home/climatechange/

Many conservation organizations, such as Ducks Unlimited, National Wildlife Federation, Audubon, and the Theodore Roosevelt Conservation Partnership, have additional information about the impacts of climate change on wildlife on their websites.

ABOUT THE AUTHOR

Dr. Wendy Gordon is an environmental professional with more than 25 years of experience managing the natural resources of Texas. Her career has spanned the private, nonprofit and government sectors. As a scientist working for the State of Texas, she led the Nongame and Rare Species Program for Texas Parks and Wildlife Department and also worked on regional water planning for the agency. At the Texas Commission on Environmental Quality, she spearheaded efforts to improve instream flow protections through water rights permitting, developed state surface water quality standards, and initiated the Corpus Christi Bay National Estuary Program. In her current role as an Austin, Texas-based consultant, her areas of focus include water conservation, land-use change, and climate change assessments. She holds a doctorate in botany from The University of Texas at Austin and a master's degree in natural resource policy from the University of Michigan's School of Natural Resources and Environment. She has published ecological, hydrologic, and climate change research in a variety of peer-reviewed journals from *Global Change Biology* and *GIScience & Remote Sensing* to *Ecological Applications* and *Eos*. She has served as an editor for the American Geophysical Union for the past eight years. She is the founder and moderator of the LinkedIn group, Texas Water, which has more than 800 members.

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