

CLIMATE CHANGE, NATURAL DISASTERS, AND WILDLIFE



CLIMATE CHANGE IS WORSENING SOME TYPES OF NATURAL DISASTERS

Sweltering heatwaves, torrential downpours, smoky skies, and toxic water. Many natural disasters are becoming more dangerous due partly to climate change, and their far reaching impacts have negatively affected people and wildlife across the United States.

Today, there is near universal consensus among the world's scientists that human activity is causing climate change.¹ The Intergovernmental Panel on Climate Change (IPCC) cautions that global greenhouse gas emissions should be cut in half by 2030 and reach net zero emissions by mid-century in order to avert the most catastrophic consequences of climate change.² Climate change in combination with other factors is putting at least one million plant and animal species at risk of extinction around the world.³

We are running out of time—already average global temperatures are 1.8°F hotter today than they were before the industrial revolution.⁴ Studies show that many different ecological processes such as food webs and species distribution are already being affected by this rise in temperature.⁵ And, warmer global temperatures are bringing about other climatic changes that can fuel and amplify natural disasters, posing additional threats to wildlife and people alike.

This document summarizes how climate change influences certain natural disasters and increases risks, and highlights policy solutions that decision makers can implement to prevent worsening catastrophes.

By October, there were 10 weather and climate disaster events in 2019 that each exceeded \$1 billion in losses.⁶

November 2019

An algal outbreak spreads across Lake Erie, 2018. Photo: Zachary Haslick

EXTREME HEAT WAVES

The National Weather Service (NWS) measures extreme heat using the Heat Index, which factors in both air temperature and humidity to determine how hot it feels to the human body. There is no standard temperature for extreme heat, but NWS initiates alert procedures when the Heat Index is expected to exceed 105°-110°F for at least 2 consecutive days. When a person is subjected to extreme heat, his or her body may not be able to properly cool itself, which can result in a heat-related illness. If a person's internal temperature reaches 104°F, all-important cellular machinery begins to break down.⁷ Heat-related illness can cause damage to the brain and other vital organs and can even be fatal.⁸

The Centers for Disease Control and Prevention reports that heat is one of the deadliest disasters in the U.S., killing an average of 658 people per year.⁹ According to the NWS, extreme heat has killed more people in the U.S. than any other natural disaster in the last 30 years,¹⁰ and a total of more than 9,000 Americans have died from heat-related causes from 1979-2014.¹¹ In Phoenix, Arizona alone, there were 182 heat-associated deaths reported in 2018.¹²

HOW CLIMATE CHANGE WORSENS EXTREME HEAT WAVES

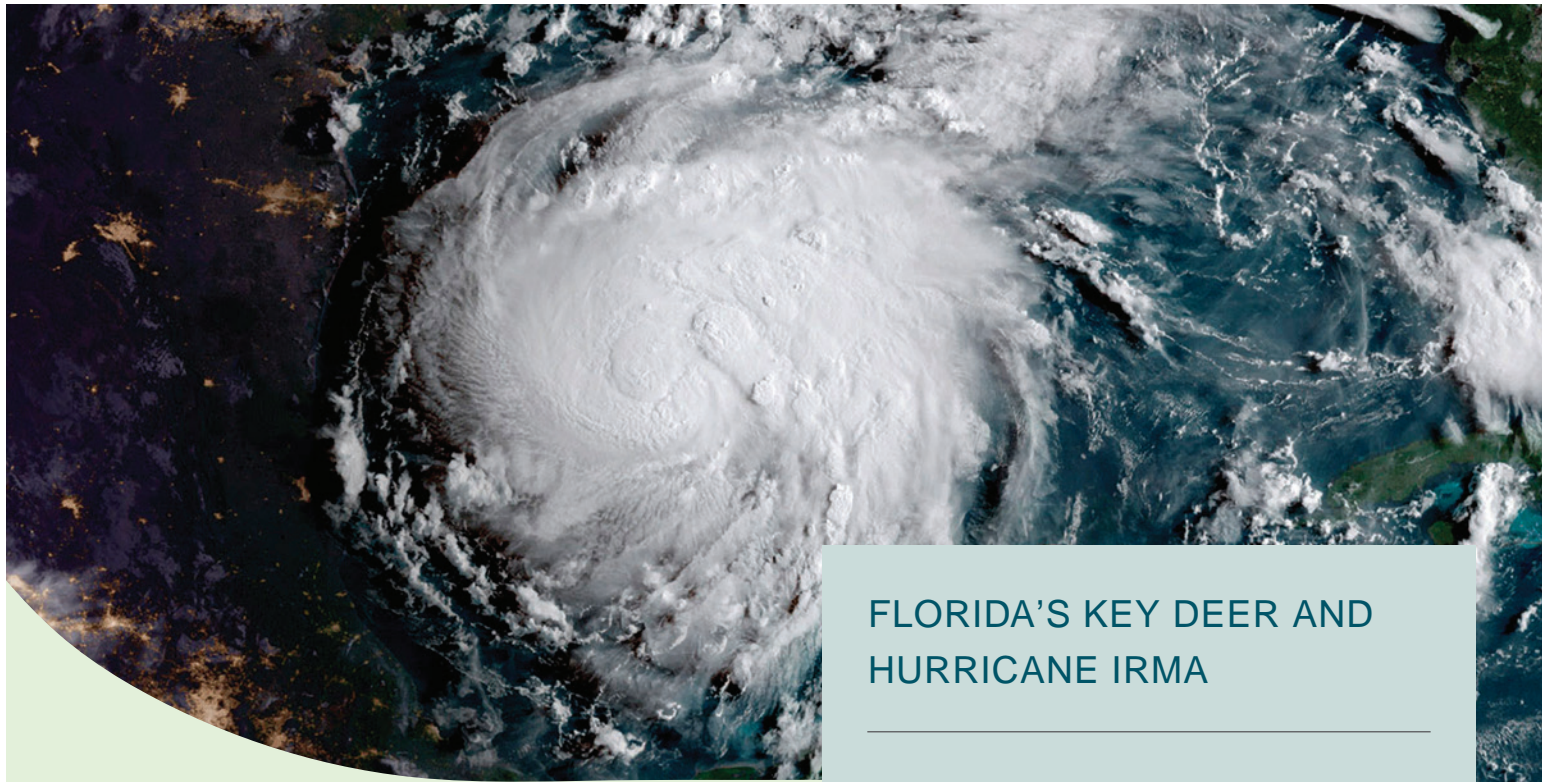
Rising average global temperatures are one of the most direct indicators of climate change. As heat trapping emissions become more concentrated in the atmosphere and temperatures rise, extreme heat waves are expected to become longer, more frequent and more severe. By 2050, if no action is taken to slow emissions, all regions of the United States will experience an increased average number of days per year with dangerous heat conditions.¹³ In fact, a recent study found that in less than 20 years, millions of people in the U.S. could be exposed to dangerous, "off-the-charts" heat waves of 127 degrees Fahrenheit or more.¹⁴ Another study found that if emissions continue to grow, 74% of the world's population will be exposed to heat waves hot enough to kill.¹⁵ However, by cutting emissions swiftly and deeply, we can slow the global temperature rise that intensifies extreme heat in the U.S., and elsewhere.

ALASKA'S SALMON AND EXTREME HEAT WAVES

Extreme heat is a major hazard for wildlife, as well. Alaska experienced its hottest month in recorded history in July 2019. According to NOAA's *National State of the Climate* report, Alaska's statewide average temperature was 7.9°F above average in 2019.¹⁶ This unprecedented heat wave killed large numbers of salmon in the state.^{17,18} Scientists observed die-offs of several varieties of Alaskan salmon, including sockeye, chum and pink salmon. The extreme heat decreased the amount of oxygen in the water, causing the fish to suffocate.¹⁹ Stephanie Quinn-Davidson, director of the Yukon Inter-Tribal Fish Commission, and a group of scientists visited Alaska's Koyukuk River at the end of July 2019 to observe the die-offs. Quinn-Davidson counted 850 dead salmon in the area, but her team estimated that the total was likely four to 10 times larger.²⁰

Sockeye salmon. Photo: Alaska Region USFWS





Hurricane Harvey was the second most expensive natural disaster in U.S. history. The Category 4 hurricane hit Texas on a Friday in 2017 and by that Sunday, it had dropped 27 trillion gallons of rain over Texas and Louisiana. Over 72,000 people needed rescuing and 14,000 National Guard members were activated to help. At least 30,000 people needed temporary shelter. The total estimated cost of Harvey is \$130 billion.²¹ Photo: NASA

HURRICANES

The energy that feeds hurricanes comes from warm water, and climate change is causing ocean temperatures to increase. The wind damage from hurricanes increases exponentially, so even a seemingly small boost in strength can dramatically increase damage. A Category 4 (130-156 mph) storm can deliver 250 times the wind damage of a Category 1 (74-95 mph) storm.²²

Also, in general, as sea surface temperatures and air temperatures rise, more ocean water evaporates into the atmosphere. The buildup of air moisture contributes to an increase in extreme rainfall. For every 1.8°F increase in global temperatures there is a seven percent increase in the moisture-holding capacity of the atmosphere. Warm water and warm air contributed to the massive rainfall from Hurricane Harvey, which dropped 27 trillion gallons of rain over Texas and Louisiana in 2017 and became the second most expensive natural disaster in U.S. history.

FLORIDA'S KEY DEER AND HURRICANE IRMA

Rare island species are especially vulnerable to the impacts of climate change, due to direct storm hazards, major habitat damage, and/or food web changes. There are approximately 20 endangered species in the Florida Keys, and many of them are found nowhere else in the world. One subspecies is the Key deer—the smallest deer in North America. According to a U.S. Fish and Wildlife Service (USFWS) survey, 14 to 22 percent of the Key deer population (which is estimated to be about 1,000 deer) was killed by Hurricane Irma.²³



Key deer. Photo: Garry Tucker

Compounding these phenomena, sea level rise creates both an elevated launch pad for storm surge and also forms an additional barrier to (backs up) water emptying from rivers into the ocean. Sea levels are rising from thermal expansion (as sea water warms it expands) as well as from melting glaciers, polar ice caps, and the great ice sheets of Greenland and Antarctica.



Blue-green algae bloom. Photo: Bill Froberg

HARMFUL ALGAL OUTBREAKS

A “red tide” refers to a harmful algal outbreak in a coastal region—an outbreak that consumes vast amounts of oxygen from salt water (suffocating ecosystems), and/or produces toxins that poison people and wildlife. Often, these outbreaks also turn the ocean water red as a result of tiny marine organisms (called dinoflagellates) growing out of control. Many coastal states suffer from this phenomenon. Inland rivers and streams can also suffer from harmful algal outbreaks. The most common type of outbreak is caused by cyanobacteria, also called blue-green algae. These tiny organisms flourish in warm, nutrient-rich water and can produce toxins that are harmful to people and wildlife.²⁴

While many factors contribute to harmful algal outbreaks, including fertilizer use, farm manure runoff, and changes in water flow, climate change and warmer water temperatures

ALGAE OVERLOAD

In July 2018, a harmful algal outbreak in Florida most likely caused the death of a whale shark—one of the first known instances of this occurring. The dead animal tested positive for a neurotoxin created by a harmful algae found in the red tide. In addition, over 100 sea turtle and manatee deaths were reported, including Kemp’s ridley turtles, a critically endangered species. Other sea life killed by the outbreak includes dolphins and goliath grouper (a giant, long-lived fish).²⁵

In 2007, researchers studied approximately one dozen dead or dying sea otters that had been reported in California.²⁶ These deaths were determined to be the result of a toxin found in blue-green algae that concentrated in a freshwater lake and washed out into the ocean. This toxin most likely became concentrated in the otter’s favorite food source, shellfish. Poisoned shellfish are also a problem for people and local shellfishing economies, as contaminated shellfish pose health risks and cannot be sold for consumption. In New England, a 2016 red tide event cost the shellfish industry \$12 to \$20 million in Massachusetts alone.²⁷



Biologist performs a necropsy on a whale shark that died during a red tide event. Photo: Florida Fish & Wildlife Conservation Commission

are significant amplifiers. More rainfall, brought on by climate change in some regions, increases runoff from agriculture fields, flushing pollutants into streams and lakes and contributing to the nitrogen and phosphorus loading that triggers the outbreaks. Plus, higher temperatures are leading to longer outbreak seasons and higher potential algal growth rates.

MEGAFIRES

There is strong evidence that the warming and drying caused by climate change in the American West is related to an increase in wildfire frequency, size, intensity, and severity²⁸—contributing to more catastrophic “megafires”—as well as longer fire seasons. In these states, climate change has accounted for about half the increase in vegetation (i.e., fuel) dryness since 1979. This influence has nearly doubled the area burned by wildfires,²⁹ and has lengthened the average wildfire season by 78 days.³⁰

While wildfires are naturally occurring and are essential for the long-term health of ecosystems, this is not the case for many of the massive fires that are occurring in the western United States. Wildfires are one of the most complex natural disasters, with many factors affecting them, including vegetation types, drought conditions, and the many ways in which people can alter a landscape (see NWF’s *Megafires* report <https://www.nwf.org/megafires-report>).

Climate change increases wildfire risk in several ways. Earlier spring snowmelt, higher temperatures (in spring, summer, and fall), and increases in evapotranspiration have extended the period in which forests and other habitats become burnable. In addition, higher temperatures and extreme drought can trigger tree stress and mortality, and exacerbate outbreaks of insects such as bark beetles—both of which can increase the susceptibility of forests to wildfire.

Climate change also causes greater seasonal extremes—wetter wet seasons and drier, hotter dry seasons. The heavy wet season can allow large amounts of vegetation to grow, which then dries up in the dry season, leaving more fuel for fires to burn.

Megafires release large quantities of carbon into the atmosphere when they burn, sometimes shifting forests from natural carbon sinks to net sources of atmospheric carbon. When the land cannot recover between more frequent and intense fires, new forest growth can’t offset emissions. Fires are estimated to release around 290 million metric tons of carbon dioxide annually,³¹ further fueling climate change.

CALIFORNIA MEGAFIRES AND WILDLIFE

While wildfires can be important for maintaining wildlife habitat, large and severe megafires can be ecologically destructive and hurt wildlife. Almost half of California’s ten largest wildfires on record occurred in the last decade.³² In one example, the 2018 Carr Fire in Redding consumed an area greater than 100,000 football fields, becoming so massive that it created its own weather system, including a “fire tornado.”³³ The 2016 Soberanes Fire burned more than 130,000 acres and cost \$260 million to suppress, killing vulnerable species like the red-legged frog and steelhead trout by damaging creeks and rivers with increased levels of sedimentation and debris.³⁴



Red-legged frog. Photo: USFWS



Mendocino County California fire. Photo: Bob Dass

AMARGOSA VOLES THREATENED BY DROUGHT

Prolonged droughts diminish food and water resources for wildlife. Small and highly specialized animals, like the endangered Amargosa vole, are often unable to relocate or adapt to dry conditions and suffer as a result.³⁵ Amargosa voles—which currently number 500 or fewer in California—are completely dependent on bulrush marsh habitat in the Mojave Desert for shelter and their only food source.³⁶ Bulrush habitat declined by 37 percent during the recent drought in California, which was the state's worst dry spell in the last 1,200 years.³⁷ Elevated temperatures and exacerbated drought due to climate change are likely to continue to reduce and degrade vole habitat, threatening the recovery of the species.



Amargosa vole. Photo: Bureau of Land Management California

DROUGHTS

Droughts are not often the first things that come to mind when talking about natural disasters. They escalate slowly and their damage is not immediately visible. They are not as dramatic as hurricanes or wildfires, but they are just as dangerous and destructive for wildlife and people.

Ecosystems, and the wildlife that depends on them, will experience a variety of impacts as droughts become more frequent and severe. Drought can lead to increases in



Drought at Folsom Lake, California, 2015. Photo: Vince Mig

wildfire and insect outbreaks, forest diebacks, and altered rates of carbon, nutrient, and water cycling.³⁸

Studies have shown that the United States is historically vulnerable to droughts, and climate change increases this vulnerability. Increased temperatures can reduce rainfall by causing subtropical, high-pressure systems to grow in strength and size. These pressure systems prevent moisture from traveling higher up in the atmosphere where it can condense and produce rain or snow. If these pressure systems do become stronger and larger as a result of climate change, they will be more active in halting precipitation and prolonging droughts. Even in places where precipitation does not decrease, the warmer temperatures will increase the amount of evaporation and lower the average moisture levels in soils.

Studies show that, with climate change, the time in between droughts is likely to become shorter than the time the land will need to recover from them. The stress caused by incomplete recovery could lead to widespread tree death and lower the amount of carbon the land can absorb, fueling a positive feedback loop and making climate change, and thus, droughts, worse.³⁹



After Hurricane Katrina, 2005. Photo: Jocelyn Augustino

FLOODS

Floods are increasing in frequency and intensity in areas of the United States and this rise is expected to continue throughout the century as a result of climate change. Warmer air can hold more moisture, meaning heavier rainfalls. As mentioned earlier, for every 1.8°F increase in global temperatures there is a seven percent increase in the moisture-holding capacity of the atmosphere.⁴⁰

Heavy precipitation events—i.e., the heaviest one percent of rainfalls—now drop 55 percent more rain in the Northeast, 42 percent in the Midwest, and 27 percent more in the Southeast, compared to 50 years ago.⁴¹ If the U.S. keeps emitting greenhouse gases at today's rates, these extreme precipitation events will occur five times as often by 2100 compared to the latter half of last century.⁴²

FLOODING AND ENDANGERED SPECIES RECOVERY

Hurricane Harvey almost wiped out one of the world's most endangered birds—the Attwater's prairie chicken. The unique birds once numbered in the thousands across the coastal prairies of Texas and Louisiana, but severe declines from habitat loss have led to an endangered status. Further exacerbating these steep declines, two floods have decimated one of the remaining wild populations. The first disaster occurred during the flooding of Tax Day in 2016, followed closely by Hurricane Harvey in 2017. The flooding from the hurricane hit the Attwater Prairie Chicken National Wildlife Refuge and dropped the wild population down to just 12 birds. A captive breeding program provides short-term security for the birds, but frequent extreme weather events will make recovery of a wild population difficult.



Prairie chicken. Photo: Nappadal Paothong

In early 2018, unprecedented rainfall hit Southern California, following closely on the heels of devastating wildfires. The results were horrifying—an avalanche of mud and debris inundated communities, destroying structures and claiming 13 lives. The insurance losses alone exceeded \$421 million.⁴³

Heavier precipitation combined with higher storm surges from hurricanes and higher rates of snowmelt all contribute to future floods risks.

POLICY RECOMMENDATIONS

Climate change is one of the biggest threats to human communities and the long-term survival of America's wildlife, in part due to worsening natural disasters. Policymakers should adopt practical solutions that will mitigate the impacts of climate change by quickly reducing greenhouse gas emissions and ensuring wildlife and natural systems are able to adapt and build resilience to unavoidable impacts.

For a more detailed look at National Wildlife Federation's policy recommendations, please visit: nwf.org/climatepolicy

REFERENCES

- ¹ Cook, J. et al. 2013. Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters*. Vol. 8, Issue 2. <http://iopscience.iop.org/article/10.1088/1748-9326/8/2/024024/meta>
- ² IPCC. 2018. Global Warming of 1.5°C. <https://www.ipcc.ch/sr15/>
- ³ IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. <https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services>
- ⁴ The Economist. 2018. The world is losing the war against climate change. <https://www.economist.com/leaders/2018/08/02/the-world-is-losing-the-war-against-climate-change>
- ⁵ Scheffers, B.R. et al. 2016. The broad footprint of climate change from genes to biomes to people. *Science*. Vol. 354, Issue 6313. <http://science.sciencemag.org/content/354/6313/aaf7671>
- ⁶ NOAA National Centers for Environmental Information (NCEI). 2019. U.S. Billion-Dollar Weather and Climate Disasters. <https://www.ncdc.noaa.gov/billions/>
- ⁷ Leahy, S. 2019. 'Off-the-charts' heat to affect millions in U.S. in coming decades. *National Geographic*. <https://www.nationalgeographic.com/environment/2019/07/extreme-heat-to-affect-millions-of-americans/>
- ⁸ Centers for Disease Control and Prevention (CDC). 2017. About Extreme Heat. https://www.cdc.gov/disasters/extremeheat/heat_guide.html
- ⁹ CDC. Heat-Related Illness. https://www.cdc.gov/pictureofamerica/pdfs/picture_of_america_heat-related_illness.pdf
- ¹⁰ National Weather Service. Weather Related Fatality and Injury Statistics. <https://www.weather.gov/hazstat/>
- ¹¹ Environmental Protection Agency. 2016. Climate Change Indicators: Heat-Related Deaths. <https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths>
- ¹² Maricopa County Public Health. 2018. Heat-Associated Deaths in Maricopa County, AZ Final Report for 2018. <https://www.maricopa.gov/ArchiveCenter/ViewFile/Item/4765>
- ¹³ Union of Concerned Scientists. 2019. Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days. <https://www.ucsusa.org/sites/default/files/attach/2019/07/killer-heat-analysis-full-report.pdf>
- ¹⁴ *Op. cit.* 7.
- ¹⁵ Lavelle, M. 2017. Deadly Heat Waves Could Endanger 74% of Mankind by 2100, Study Says. *InsideClimate News*. <https://insideclimatenews.org/news/19062017/heat-waves-world-population-risk-endangered-climate-change-study>
- ¹⁶ NOAA. 2019. State of the Climate. <https://www.ncdc.noaa.gov/sotc/>
- ¹⁷ Stone, M. 2019. Dying Salmon, Wildfires, Heat Waves, Vanishing Ice: In Alaska, Climate Change Is Impossible to Ignore. *Rolling Stone*. <https://www.rollingstone.com/politics/politics-features/dying-salmon-wildfires-heat-waves-vanishing-ice-in-alaska-climate-change-is-impossible-to-ignore-896284/>
- ¹⁸ Berwyn, B. 2019. Alaska Chokes on Wildfires as Heat Waves Dry Out the Arctic. *InsideClimate News*. <https://insideclimatenews.org/news/11072019/arctic-wildfires-alaska-climate-change-heat-wave-2019-university-funding>
- ¹⁹ ABC7 News. 2019. Scientists say heat wave is killing large numbers of salmon in Alaska. <https://abc7news.com/society/heat-wave-causing-salmon-die-off/5475563/>
- ²⁰ Prior, R. 2019. The water is so hot in Alaska it's killing large numbers of salmon. *CNN*. <https://www.cnn.com/2019/08/16/us/alaska-salmon-hot-water-trnd/index.html>
- ²¹ Griggs, B. 2017. Harvey's Devastating Impact by the Numbers. *CNN*. <http://www.cnn.com/2017/08/27/us/harvey-impact-by-the-numbers-trnd/index.html>
- ²² NOAA. 2014. How does the damage that hurricanes cause increase as a function of wind speed? <http://www.aoml.noaa.gov/hrd/tcfaq/D5.html>
- ²³ Nobel, J. 2017. Recent Hurricanes Pushed Rare Island Species Closer to the Brink. *National Geographic*. <https://news.nationalgeographic.com/2017/10/hurricane-irma-hurts-florida-keys-wildlife/>
- ²⁴ CDC. 2018. Harmful Algal Bloom (HAB)-Associated Illness. <https://www.cdc.gov/habs/index.html>
- ²⁵ Furby, K. 2018. A red tide ravaging Florida may have killed a whale shark for the first known time. *The Washington Post*. <https://www.washingtonpost.com/news/speaking-of-science/wp/2018/08/03/a-red-tide-ravaging-florida-may-have-killed-a-whale-shark-for-the-first-known-time/>
- ²⁶ CDC. 2017. Poisoned Sea Otters in California. <https://www.cdc.gov/onehealth/in-action/poisoned-sea-otters.html>
- ²⁷ Anderson, D. 2016. Economic Impacts. Woods Hole Oceanographic Institution. <https://www.whoi.edu/redtide/impacts/economic>
- ²⁸ Westerling, A. L. et al. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. *Science*. Vol. 313, Issue 5789. <http://science.sciencemag.org/content/313/5789/940.full>
- ²⁹ Abatzoglou, J.T., Williams A. P. 2016. Impact of anthropogenic climate change on wildfire across western US forests. <https://doi.org/10.1073/pnas.1607171113>
- ³⁰ U.S. Department of Agriculture (USDA). 2015. The Rising Cost of Wildlife Operations: Effects on the Forest Service's Non-Fire Work. *PNAS*. Vol. 113 Issue. 42. <https://www.fs.fed.us/sites/default/files/2015-Fire-Budget-Report.pdf>
- ³¹ National Science Foundation. 2007. U.S. Fires Release Enormous Amounts of Carbon Dioxide. www.nsf.gov/news/news_summ.jsp?cntn_id=110580
- ³² Whitcomb, D. 2018. Largest wildfire in California history to burn for rest of August. *Reuters*. <https://af.reuters.com/article/worldNews/idAFKBN1KS0PO>
- ³³ Vercammen, P. et al. 2018. Carr Fire in California is so hot it's creating its own weather system. *CNN*. <https://www.cnn.com/2018/07/30/us/carr-fire-california/index.html>
- ³⁴ USDA. 2016. Draft Soberanes 2 Burned Area Report. <https://www.co.monterey.ca.us/home/showdocument?id=14136>
- ³⁵ California Department of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program. 2016. A Rapid Assessment of the Vulnerability to Extreme Drought. <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=118299&inline>
- ³⁶ Foley, J. et al. 2017. Range-wide assessment of the endangered Amargosa vole and analysis of critical habitat stressors. University of California, Davis. A Report to the California Department of Fish and Wildlife. <https://ucdavis.app.box.com/s/tee0bm39zql0490jfl716t70z20ttf1/file/181229526551>
- ³⁷ Griffin, D. and Anchukaitis, K. 2014. How unusual is the 2012-2014 California drought? *Geophysical Research Letters*. Vol. 41, Issue 24. <https://doi.org/10.1002/2014GL02433>
- ³⁸ U.S. Geological Survey. 2017. Ecological Drought Across the Country. <https://casdc.usgs.gov/science/ecological-drought>
- ³⁹ NASA. 2017. Study Finds Drought Recoveries Taking Longer - Climate Change: Vital Signs of the Planet. <https://climate.nasa.gov/news/2617/study-finds-drought-recoveries-taking-longer/>
- ⁴⁰ IPCC. 2014. Heavy Precipitation. <https://www.globalchange.gov/browse/indicators/heavy-precipitation>
- ⁴¹ U.S. Global Change Research Program (USGCRP). 2018. National Climate Assessment. Figure 2.6 Observed and Projected Change in Heavy Precipitation. <https://nca2018.globalchange.gov/chapter/2/>
- ⁴² USGCRP. 2014. National Climate Assessment. Figure 2.19: Projected Change in Heavy Precipitation Events. <https://nca2014.globalchange.gov/report/our-changing-climate/heavy-downpours-increasing>
- ⁴³ Barlyn, S. 2018. California mudslide insurance losses exceed \$421 million: regulator. *Reuters*. <https://www.reuters.com/article/us-california-mudslides-insurance/california-mudslide-insurance-losses-exceed-421-million-regulator-idUSKCN1H91PK>

An owl hunts at Aransas National Wildlife Refuge in Texas as flames sweep the brush. Photo: Jeffrey Adams/USFWS