Chapter 4

Droughts

Drought can be defined as "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected areas" (American Meteorology Society, 1959). In other words, drought is a period without rain or snow where normal conditions are changed, such as a lack of soil moisture or reductions in water supplies (water tables, lake levels, streamflow, etc.). Often, we see short-term events as turning points in weather patterns, but we need to step back and look at the bigger picture. A week of cold weather in June does not prove global warming is false, just as a week of rain in October does not define the end of the drought.

Nevada is the driest State in the Union. With this in mind, one might argue that the people in Nevada live with drought all the time. While it certainly is dry in Nevada, the people still depend on a level of annual precipitation to keep their aquifers replenished and their streams flowing so that they can irrigate crops and fields. Often, winter snow pack in the mountains provides the precipitation to maintain the water balance for the rest of the year. Reductions in that snow pack can mean drought conditions for the valleys.

So, can drought be defined by a lack of precipitation, or a decline in soil moisture, or a drop in streamflow, or when water restrictions are put in place on various cities and areas? The answer is yes to all four. Drought can be defined in reference to meteorological, agricultural, hydrological, or socioeconomical standards (National Oceanic and Atmospheric Administration, 2005).

Meteorological drought refers to a period when the amount of precipitation is below normal. This standard can be highly variable from one location to another. For example, let's say that rainfall in Carson City was below normal for a year. However, the precipitation in the Sierra Nevada adjacent to Carson City was at or above normal for the same year. By definition, Carson City would be in a drought, while the nearby mountains are not. The reality is that much of the moisture from the mountain precipitation probably will flow into the valley and therefore supply sufficient water for crops and aquifer recharge, but the valley is still considered under a meteorological drought.

Agricultural drought refers to conditions when soil moisture is insufficient to meet crops needs. Because crops in Nevada depend on irrigation for survival, this definition does not apply to Nevada by itself. However, because drought can affect hydrological conditions, which supply water for irrigation, agricultural drought can be related to hydrological drought. In many places in the Eastern U.S. where irrigation is not used, agricultural drought is a very serious subject.

Hydrological drought refers to conditions when snowpack, lake levels, streamflow, and ground-water levels are below normal. In a desert environment like Nevada, this type of drought condition is the most serious. Declines in Nevada's water supplies can affect the ability to irrigate crops, maintain habitat for animals (wild and domestic), and provide for human needs.

Socioeconomic drought is when water shortages begin to affect the people. In some cases, a deficit of precipitation can have little effect on people if there are sufficient supplies to keep things as "business as usual." A lot of this depends on the amount of water in storage and the length of time of the drought. In other cases, a deficit in precipitation (and related declines in water supplies and soil moisture) can have huge socioeconomic effects; for instance, during the "Dust Bowl" era, people were displaced and ways of life changed. When drought causes a change in lifestyle or business practices, then it has a socioeconomic effect.

Drought typically is measured using a number of different indices. One is the Percent of Normal, which is a measure of precipitation compared to "normal precipitation," typically considered the 30-year average. Another index is the Standardized Precipitation Index (SPI) which is based on the probability of precipitation for any time scale and can provide an early warning of drought and assess drought severity. The Palmer Drought Severity Index (PDSI) is a meteorological drought index based on soil moisture. The Crop Moisture Index (CMI) is similar to the Palmer Index and uses moisture supply as required by certain crops. The Surface Water Supply Index (SWSI) is calculated by river basin and is based on snowpack, streamflow, precipitation, and reservoir storage. The Reclamation Drought Index (RDI) is calculated for river basins and uses the same parameters as SWSI, plus temperature. Most drought observers use one or more of these indices to evaluate drought conditions.

The severity of drought can depend on where you live. In parts of the country where rainfall is critical for crop production and quality of life (lawns, golf courses, etc.), a few weeks without rain can cause great concern. In the Southwest U.S., where rainfall is less common, it might take prolonged periods (months or even years) before people feel the effects of drought. For example, people in southern Nevada depend on Lake Mead for their water supply. Lake levels depend on flow from the Colorado River, which is supplied mainly from precipitation in the upper basin (Colorado, Wyoming, and Utah). A prolonged drought in the Western U.S. might not have immediate effects on water supplies from Lake Mead, but over time, the effects would be cumulative and become more apparent to the general public.

Declines in water levels in Lake Mead create a "bathtub ring" effect as rocks that were previously submerged became exposed along the lake edge, September 2004. Photographs by Ryan Rowland, USGS.

One effect of drought that we all can relate to is the increase in forest fires. Fire potential increases as conditions become drier. During a drought in California around 1970, fires accounted for tens of millions of dollars in losses. The drought between 1984 and 1988 had huge effects on agricultural production. During this period, over 4 million acres of forest burned in the Northwest and over half of Yellowstone National Park, or about 2 million acres, was affected by a huge forest fire.

The drought of the 1930s lasted up to 7 years in some parts of the country and resulted in a mass migration of people from the Great Plains. The cost of losses related to the 1987–89 drought in the U.S. was estimated to be as high as $39 billion. As populations continue to grow, the effects of droughts on humans also will increase.

Scientists have been able to examine climate conditions that existed prior to recorded history in the Western U.S. by using paleoclimate data. These data consist of climate conditions recorded in tree rings, lake sediments, ice cores, and other features that are affected by changes in the environment. Tree ring records are abundant for the last few hundred years, and in some cases hold records for the last 2,000 years. Lake

sediments and ice cores can extend even further back, often many thousands of years. The paleoclimate data indicate that many past droughts appear to have been much worse than those experienced during the last 100 years, both in duration and intensity.

In conclusion, droughts are naturally occurring weather patterns that result in a water deficit for an area. The effects of drought on humans relates to reduced water supplies, wells going dry or reduced well production, reduced soil moisture, stresses on the ecological system, increased fire potential, reduced crop production, and often water rationing. Droughts have occurred throughout time, but no one can accurately predict how intense a drought will be or how long it will last. Like the weather, all we can do is prepare for what might come and try to minimize the impacts on our lives.

Amargosa River near the California-Nevada state line.