WILL THE 2014 DROUGHT IN CALIFORNIA SET A RECORD?

By Maury Roos[1]

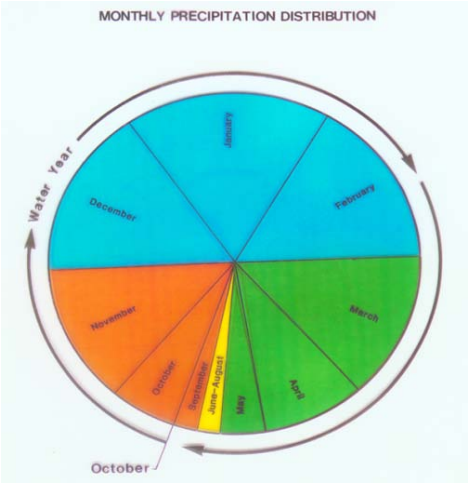
ABSTRACT

Once again, severe drought is affecting California snowpack and water supply. Water year 2013 in California ended on a dry note with depleted reservoir storage. The new water year got off to a record poor start in many places with extremely low precipitation and snowpack. At the end of January, it looked like 2014 could become the driest water year of record. February arrived with above normal precipitation to avert a dire situation. However, 2014 is still one of our driest water years, probably to rank 4 in over 100 years. This paper will examine precipitation, snowpack, runoff, and reservoir storage in this third year of drought in California. (KEYWORDS: drought, California, precipitation, extreme, reservoir storage)

PRECIPITATION

It has been nearly 40 years since the drought year of 1977, which was the driest water year in the 20th century in California. Previously, 1924 held the record, although 1931 in the middle of the 6 year (1929-1934) drought was not far behind. For a while, 1991, the 5th year of the more recent 6 year drought of 1987-1992, looked like it might eclipse 1977. But a "miracle March" with 3 times normal precipitation saved California from a dire situation that year, adding enough water to meet the most pressing needs. For a while, the current 2014 water year looked like it would set a new dry record. But 120 percent of average precipitation statewide in the month of February eased the worst of the problem. However, 2014 is still expected to be one of our drier water years, even with normal spring rains, and is likely to be ranked 4th driest with current runoff projections. March rains seem to have been near average in the northern part of the State, ensuring total runoff will stay above record minimums.

Most of California is in a Mediterranean climate zone with strong seasonality in precipitation. The winters are wet and summers are dry and mostly cloudless, except for fog along the coast. Figure 1 shows the average monthly distribution of precipitation (rain and snow water) in northern California. About half comes during the 3 midwinter months; December, January, and February, and about ¾ occurs during the 5 months from November through March. Precipitation is quite variable from one year to the next, illustrating the need for substantial reservoir storage to carry water from the wet years to the dry ones. The Californian reservoir system, with about 43 million acre-feet of total storage, does pretty well for single dry years, but multiple dry years can lead to water shortages.



Calendar year 2013 (January through December) gained a great deal of publicity as being the driest year of record at many locations across California. 2013 exceeded previous dry calendar years by a wide margin (about 1/3), such as 1923 and 1976, both of which led to subsequent critically dry years in 1924 and 1977. Figure 2 shows the monthly precipitation for WY 2013 into April 2014, compared to the average (horizontal bar lines) for the northern Sierra Nevada; the source of a major share of the State's water supply. This is a region which averages 50 inches of annual precipitation, much in the form of winter snow. Note the good start in the first part of WY 2013 in November and December. After December, only two of the drier months, June and September, had above average rainfall, but the amounts were low. These showers were helpful for fire control, but contributed little to water supply.

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SNOWPACK AND RUNOFF

Figure 3 shows the 2014 snowpack accumulation for a mid-Sierra section of the range compared to last year, the average, the very wet 1983, and the very dry 1977, based on our snow sensor network. The water content somewhat matches the driest year of record, possibly a slight bit above from an end of month storm in March. This year the middle Sierra region SWE was best with appreciably less in the northern regions, especially the North Coast region.

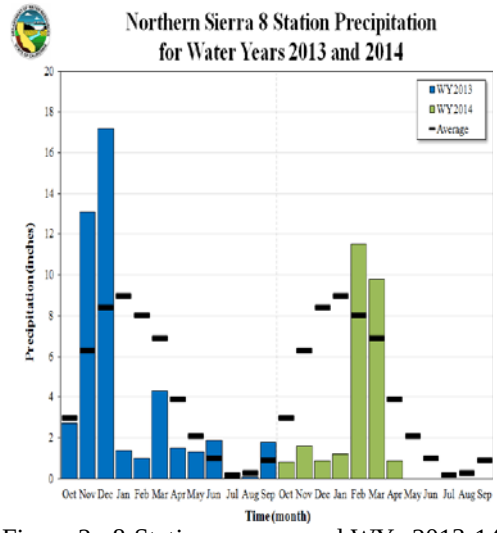

Figure 2. 8-Station average and WYs 2013-14

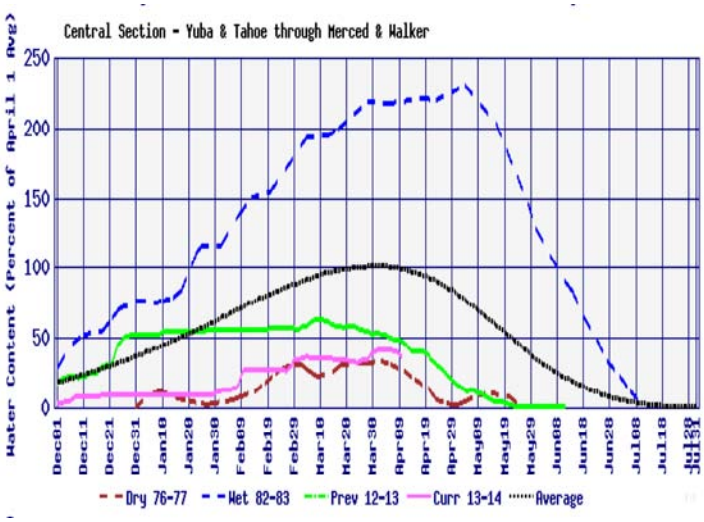

Figure 3. 2013 and 2014 snowpack in mid-Sierra

Figure 4 shows the history of our April 1 snowpack since 1980. It appears that the current year, 2014, is the lowest in 35 years, only slightly exceeding that of 1977. For portions of the Sierra, there has been a downward trend in snowpack water content (Figures 5 and 6); however, the southern Sierra has shown a slight upward trend (Figure 7). The first snowpack trend figure (Figure 5) for 13 northern Sierra courses did include Lake Spaulding snow course, which might be affected also by soot and dust from a major freeway route, Highway 80 over Donner Pass, as well as a major railroad. Leaving this course out did flatten the slope a bit to 6 percent as shown by the 12 course figure (Figure 6). More noticeable, the portion of water year runoff during the April through July snowmelt period has decreased over the entire Sierra range, more so in the Sacramento River system (Figure 8), and a smaller slope, about 6 percent per century, in the San Joaquin River system drainage.

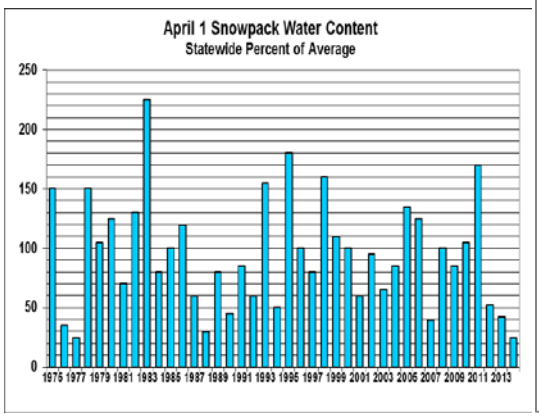

Figure 4. April 1 SWE, 1975 - 2014

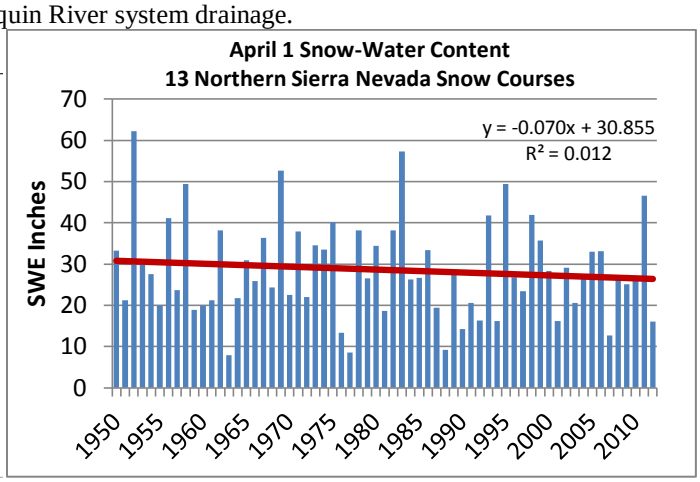

Figure 5. April 1 SWE, 13 N. CA snow courses

The next figure (Figure 9) shows the recent history of Sacramento River system unimpaired (essentially natural) runoff, color coded in the 5 categories used for water supply in the Sacramento River Index. The last bar on the right is the forecasted amount for 2014 on April 1, with the 10 – 90 percent band at the end indicating the likely probability range as the rest of the water year unfolds.

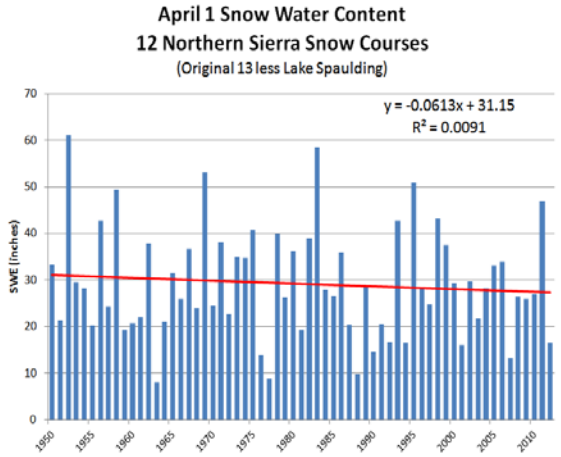

Figure 6. April 1 SWE, N. CA courses w/o L. Spaulding

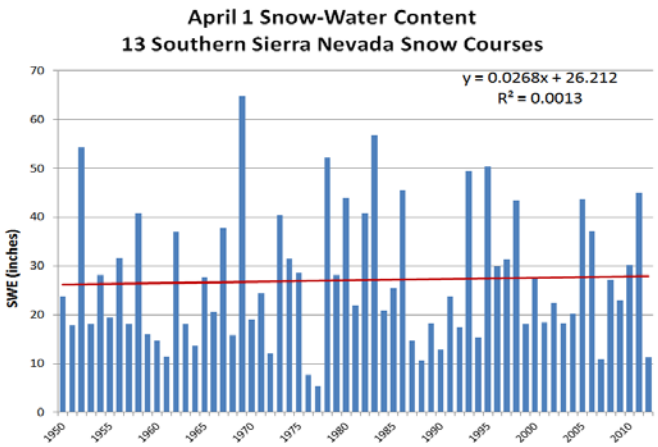

Figure 7. April 2 SWE, S. CA snow courses

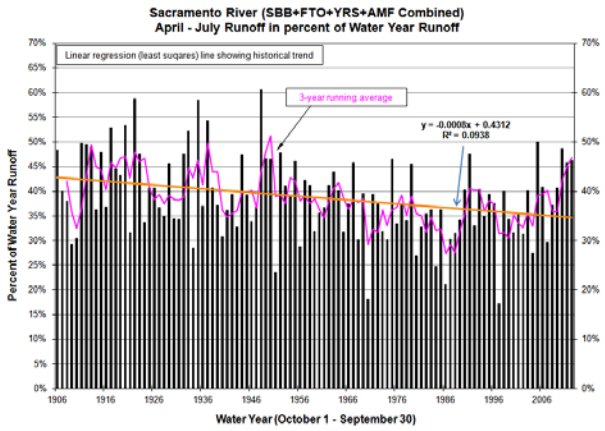

Figure 8. Sacramento R. AJRO, % of water year runoff

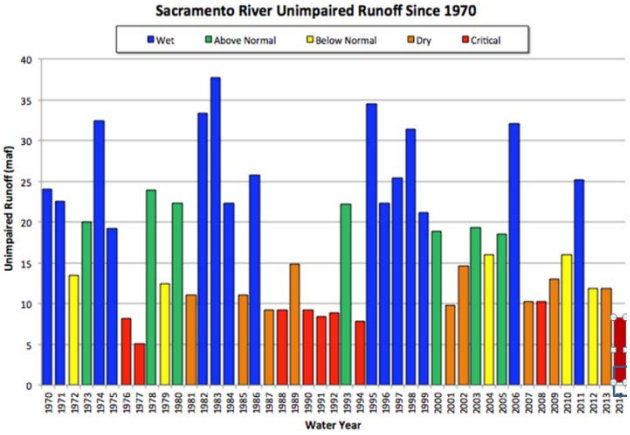

Figure 9. Sac. R. runoff, sequence of WY types

STORAGE AND DROUGHT

Figure 10 shows estimated statewide reservoir storage at the end of March for this year and previous years, including the driest in 1977 and the close call in 1991. By the end of December 2013, statewide storage had fallen to 70 percent of average for the date, thereby reaching our hydrologic threshold for drought when paired to water year runoff in the lowest 10 percent of years. Soon after, with bleak moisture forecasts, Governor Brown declared an official drought, issuing a call for a 20 percent reduction in urban water use and trying to streamline potential water transfers where useful with the reduced supplies available. January continued nearly rainless until a small

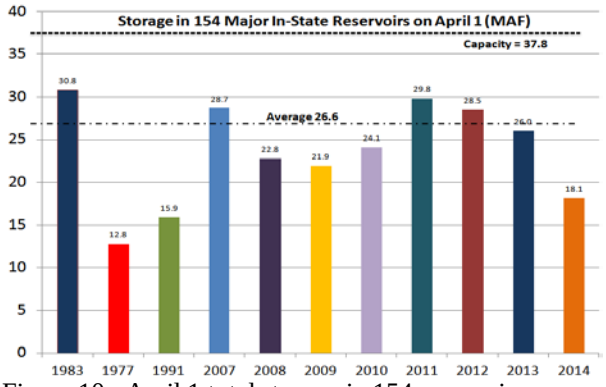

Figure 10. April 1 total storage in 154 reservoirs

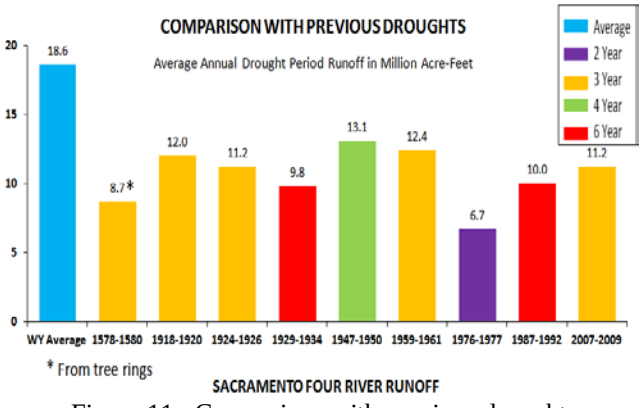

Figure 11. Comparison with previous droughts

storm occurred at the end of the month. On January 28, Sacramento City had 52 days of no measurable rain, exceeding the previous winter dry spell record of 46 days set in 1884 and 44 days in 1976. All of this during our primary rainy season!

Figures 11 and 12 are a comparison of past drought periods of various lengths in the Sacramento and San Joaquin four river systems. The 3 year average for 2012-14 will probably be between 10 and 11 million acre-feet. But longer estimates reconstructed from tree ring studies indicate considerably worse periods in past centuries, as depicted in Figures 11 and 12.

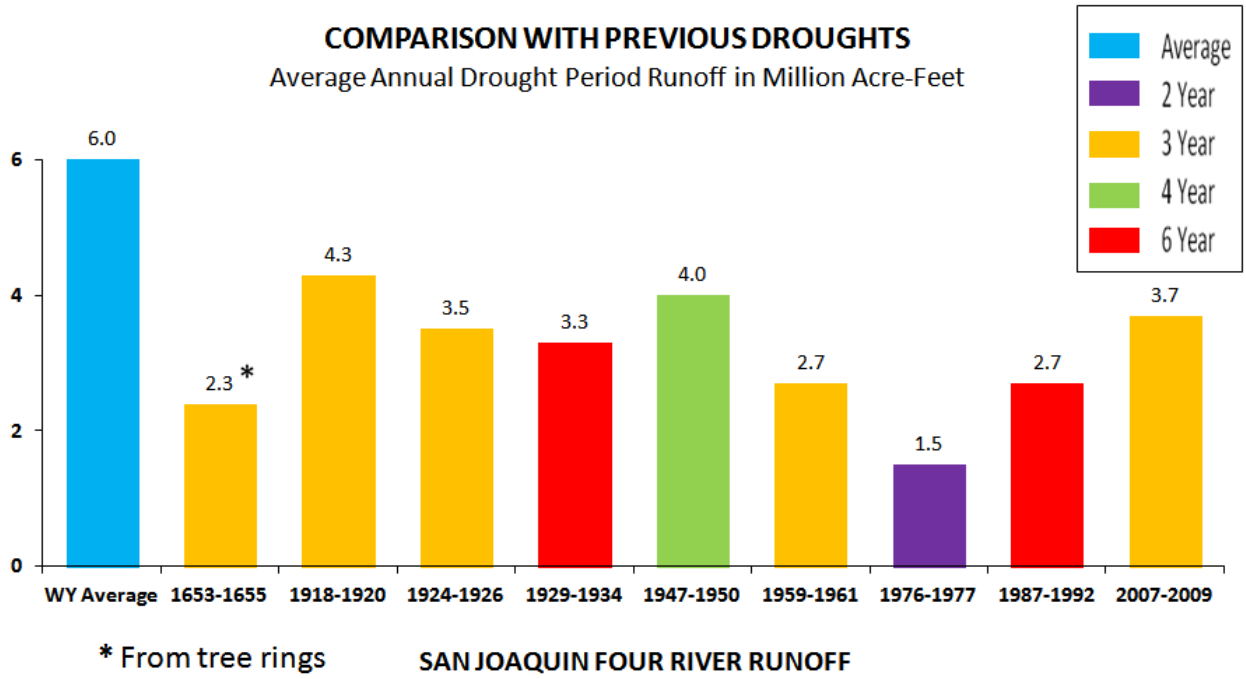

Figure 12. San Joaquin four river runoff, comparison with previous droughts

At the end of January, comparable years in a 90 year northern Sierra record seemed to be 1991, in which severe shortages were averted by a triple “miracle March.” The other comparable water year was 1977, which saw some rain in February and March, but went on into our record books as the driest runoff year of record. As this is written in April, it looks like an above average February and March have eased the worst outlook, but Northern Sierra precipitation will likely still be in the worst 10 percent of years. While we can hope and pray for a major late season surprise, avoiding some severe hardships to agriculture and perhaps fisheries in California in 2014 is unlikely. Hopefully next year will see a return of the rains to California and we will not set a new record.