

Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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The Endless Winter

Two weeks ago things were pretty soggy and there wasn't an end in sight. In the interim, and with more rain, we moved from the 22nd wettest year in the history of Santa Cruz, to number 8 as of February 27, with over 44 inches of rainfall. Boulder Creek is pushing 90 inches.

Despite the floods and mud, the downed trees and damaged roads, the electrical outages and other inconveniences, I'm guessing most of us feel that we're far better off than we were 6 months ago with groundwater levels rising and Loch Lomond full (in fact its listed as 101.4% full- how do you do that?).

In the 125-year precipitation history of Santa Cruz there have been three short intervals of well above average rainfall: 1940-1943 averaged 47.2 inches/yr.; 1982-1983, averaged a whopping 50 inches a year; and 2005-2006 averaged 43.1 inches/year.

While we don't have local rainfall records from the winter of 1861-1862, this was without doubt the wettest winter across the entire west experienced in recent memory. It extended from Canada all the way to northern Mexico.

The combination of weeks of continuous rains and snow in the higher elevations that began in November 1861, continued into January 1862, and was amplified by

warm intense rains that melted the snow, contributing to runoff. Floods devastated the entire state - the worst in the state's historical record - with a massive lake (300 miles long and averaging 20 miles in width and up to 30 feet deep) covering much of the Central Valley.

The new Capitol of Sacramento, which had been built at the confluence of the Sacramento and the American rivers, was completely under water for sixty days, and led to the temporary relocation of the capitol to San Francisco.

We have had more extended dry periods, however, than wet ones. 1912-1913 averaged 17.1 inches of rain per year; 1917-1918 averaged 15.6 inches; in the three years from 1929-1931 there was more than one depression, rainfall averaged 17.3 inches. The all time driest to date, however, was the 1976-1977 period with just a 14.9-inch average. Then the drought we just emerged from, four years from 2012-2015, averaging just 16.2 inches/yr.

The west has suffered through much longer droughts, however, and among some of the best and oldest records left behind are the tree rings of Bristlecone pines from southeastern California. These trees can live as long as 5000 years and the width of their annual rings gives us a good idea of just how much moisture was around every year.

The southwest has experienced what have been designated as mega-droughts, extended periods with well below normal rainfall. Between about 1250 and 1350, a century-long drought hit the Sierra Nevada area. Another longer drought has also been identified between AD 900 and 1100, although this may have been a series of decade-long droughts with some brief respites in between.

The only thing that could be said about the consequences of such a mega-drought occurring in this century for our cities and agriculture is that it isn't going to be pretty. And one very consistent predicted impact of our continually warming climate is for more and longer droughts. Changes in rainfall and evaporation will have significant impacts on snow packs, stream flow, soil moisture, and water availability.

The economic and environmental impacts of extended droughts are significant and we just witnessed four years of those. In good years the Sierra Nevada snowpack stores 30% of California's water supply, and is a critical reservoir for California's 39 million people and also our vast agricultural industry.

The 2012-2015 drought cost the state's economy \$2.74 billion and 21,000 jobs. Lack of surface water runoff also led to additional groundwater depletion, which has become a serious issue.

Climate change is going to have some very wicked impacts on California that we may be just beginning to feel. Its time to start making major commitments nationally and globally to doing everything we can to mitigate the impacts of climate change. California continues to be a leader in these efforts and sets a high bar for other states and the nation.