## FIdalgo Island Climate History Since 1900

*By Jon Ranney*

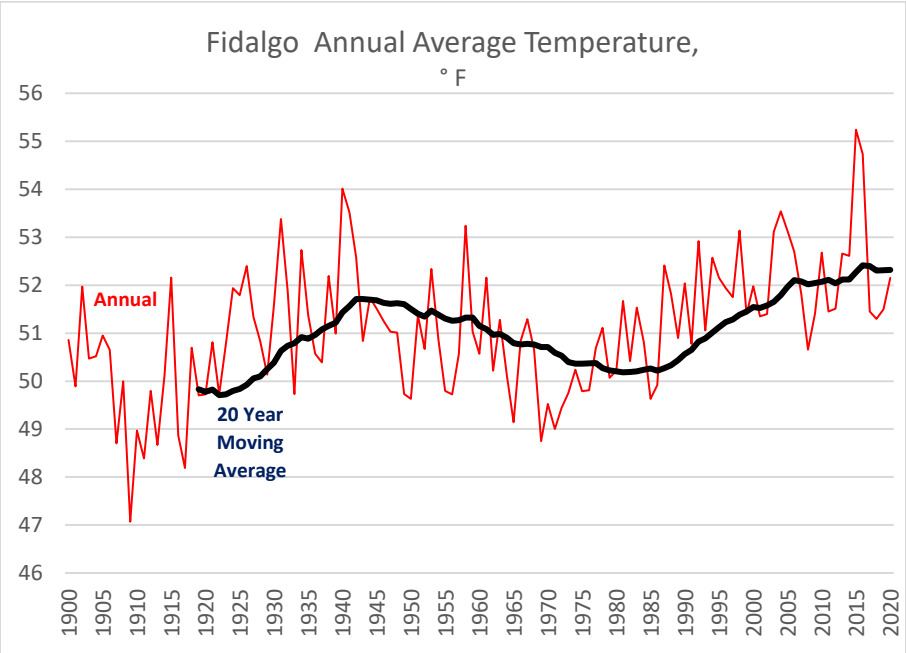
A volunteer "citizen science" group, the Fidalgo Forest Stewards, is conducting a long-term forest monitoring program in the Anacortes Community Forest Lands (ACFL) that will help scientists understand the effects of climate change on forest conditions. In conjunction with the forest monitoring, the group is keeping a daily record of temperatures and rainfall on Fidalgo Island that will eventually serve as the basic measure of the magnitude and pace of climate change that occurs locally.

Climate change may already be having an impact on the ACFL. In addition to being warmer, seven of the last ten summers have been drier than normal, and four of the last six have been exceptionally dry. During that time, local observers have seen a decline in the health of the western red cedars in the ACFL, with large numbers of trees dying in some areas.

According to the University of Washington Climate Impacts Group, most climate change models predict that future summers in the Puget Sound region will be not only warmer, but also drier than in the past. If a pattern with more frequent dry summers does emerge, in all likelihood there will be further declines in the cedar population along with other changes in the forest ecosystem.

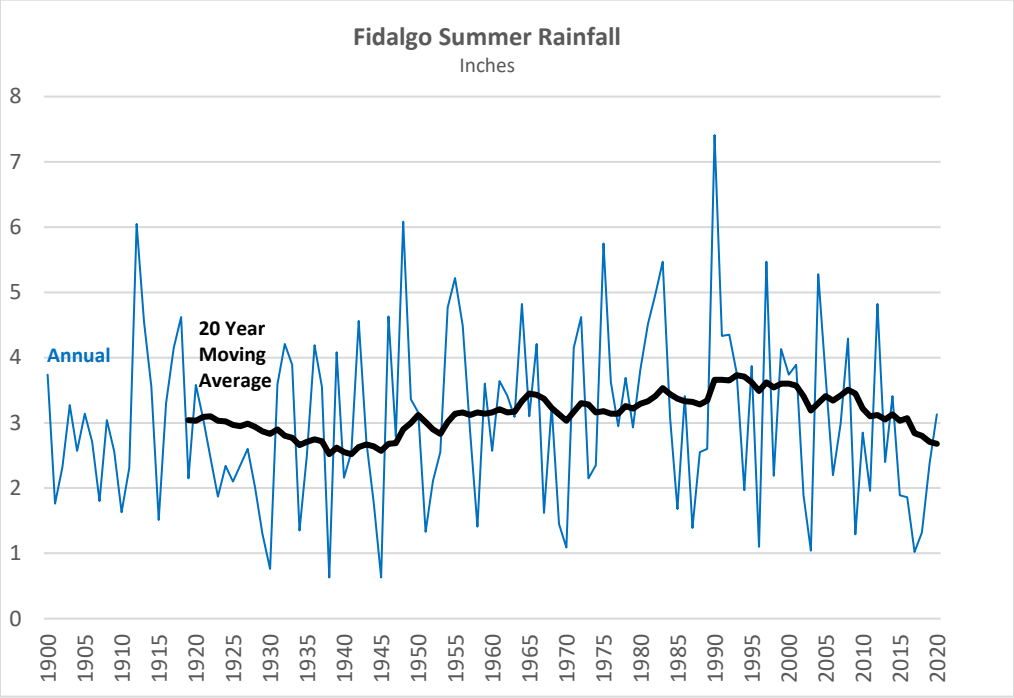
The volunteer group has compiled a daily weather history for Fidalgo starting in the year 1900 to establish a baseline and to understand the magnitude of change that has already occurred. Not surprisingly, the record clearly shows a warming trend that is consistent with the warming that has been observed globally during the same time period.

How much warmer is it? Averages calculated over two or three decades offer one way to answer this question. A climate observer in the early 1920s looking at the temperatures during the previous 10 to 20 years would have said the average temperature on Fidalgo was about 50 degrees Fahrenheit. Today, the average temperature over the last 20 to 30 years is over 52 degrees. The increase of more than two degrees is clearly illustrated in the graph below showing the 20-year historical average of annual temperatures in each year starting in 1919. A plot of this "moving average" illustrates the long-term climate trends more clearly than the annual data because it inherently smooths out the variations that occur naturally over shorter time periods.



The moving average traces a wave-like pattern, with rising temperatures in the early part of the 20th century, followed by a period of falling temperatures until around 1970, when temperatures began to increase again. The change in direction is reflected in the moving average a few years later. Global temperatures since the 1900's exhibit a similar pattern. Some scientists have referred to the warming trend ending around 1940 as the "Early Twentieth Century Warming," and the subsequent period as the "Mid-Century Cooling." Of course, we now know that the mid-century cooling was only a pause in the long-term warming trend, and it's likely that we'll start seeing more frequent extremely warm years like 2015 when the average temperature went above 55 degrees, more than four degrees above the 20th century average.

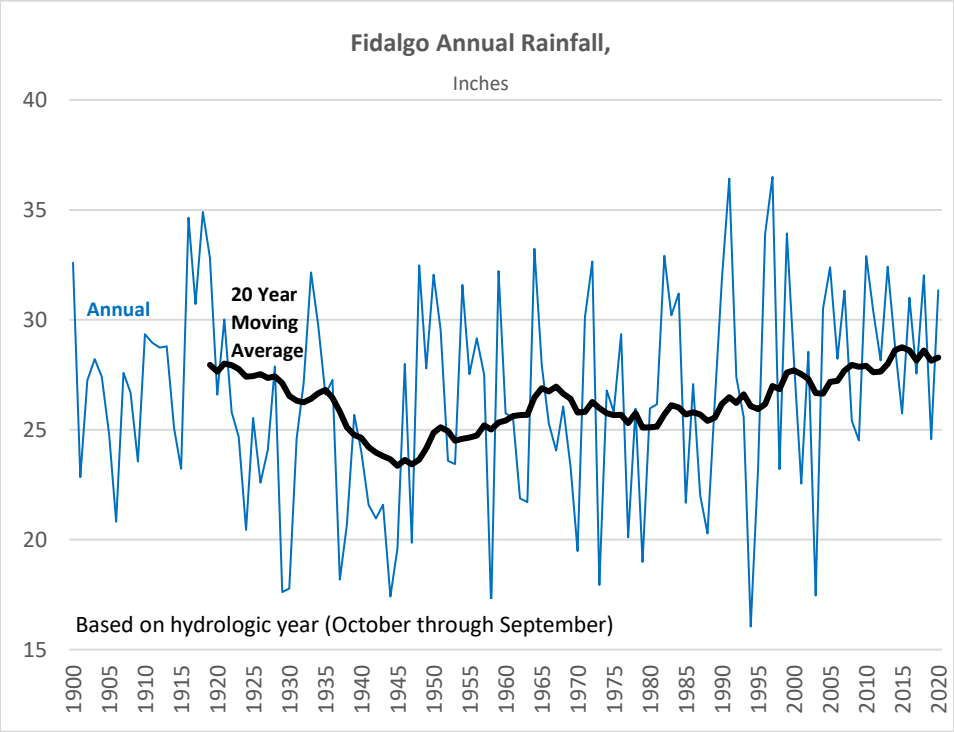
What about rainfall? Has there been a similar long-term trend towards the drier summer weather that the climate models predict? As the graph below shows, the answer is no, not yet. Twenty-year average summer rainfall (June through August) actually increased gradually for over 50 years from lows around 2.5 inches in the late 1930s to an all-time high of about 3.7 inches in the early-1990s.




Nevertheless, it's possible that the expected drying trend has started. After leveling off through the 1990s, the twenty-year average began to fall, reaching long-term average levels around 3 inches by the mid-2010s. After a wet summer in 2012 and another in 2014 with moderately higher than normal rainfall, Fidalgo had an unprecedented period of five years of exceptionally dry summer weather. The four summers from 2015 through 2018 are the only four consecutive summers with less than 2 inches of rainfall, and the five-year summer rainfall average for 2015 through 2019 is the lowest on record. This dry period brought the current 10-year average down to less than 2.5 inches, about the same as the average seen during the mid-1930s.

On the other hand, there have been extended periods in the past with frequent dry summers, and a few individual summers had less rainfall than any of the recent ones. For example, there were nine consecutive summers from 1922 through 1930 with lower-than-average summer rain, including an extremely dry summer in 1930 when total rainfall was less than eight-tenths of an inch.

There is some good news for thirsty trees. Total annual rainfall averages have increased over the past 75 years, primarily due to increases in spring and fall rain. And, unlike many of the years with dry summers of the 1920s, 1930s, and 1940s, total rainfall in each of the years 2015 through 2018 was well above the long-term average.




Eventually the continuing record of daily weather will show us whether established rainfall trends continue, and how well the climate models predict the future. In the meantime, the weather data will be an important element in the forest studies at a more detailed level. For example, the volunteer group is surveying cedar trees in selected locations in the ACFL to monitor changes in the trees' overall health. Soil moisture is being measured continuously in some of these same areas. In combination with the rainfall record, the data from these two components of the monitoring program will show over the years how soil moisture responds to the annual rainfall cycle, and how overall tree health improves or declines in turn. This should provide a more detailed understanding of the limits of the cedars' ability to tolerate periods of dry summer weather.

Given the slow pace of climate change relative to the frequency of normal annual weather variation and medium-term natural weather cycles, it may be at least a few decades before we know how local rainfall patterns change with a more rapidly warming global climate. But over the next several years, the volunteers' work will begin to show how weather variations impact forest conditions and provide some valuable insights as to what changes we may see in the forest in a warmer future.