REPORT FROM THE FIELD
JUNE ‘18

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With
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Even with a number of late winter rain storms (mostly in March), this past winter was the fourth driest in the last twenty one years with only four rainstorms through February and ten total for the entire winter/spring rainy period. The first storm occurred on 16 Nov ’17; depositing only 0.02 inches of rain in the rain gauge at the Reserve’s maintenance yard weather station. This amount is well below the rainfall amount, 0.5 to 0.6 inches, the researchers believe is required to have adequate soil moisture to trigger any poppy seed germination. This winter’s only significant early season rain storm occurred on 8 to 9 January ’18 during which the maintenance yard weather station recorded 1.69 inches of rainfall. A modest number of young poppy seedlings were found following this storm; more on this below. The third rain storm occurred on 12 to 13 Feb ’18 when the maintenance yard weather station received 0.16 inches of rainfall and the fourth storm on 26 February with 0.28 inches recorded by the maintenance yard weather station. March itself had five additional rain storms starting on 1to 3 March and ending on 20 to 22 March. Starting with the first March storm the recorded rainfalls were 0.39, 0.11, 0.21, 0.22 and 1.33 inches. The last rainstorm of the season occurred on 16 April with a recorded rainfall of 0.05 inches at the maintenance yard. Figure 1 provides a plot of these storms. It should be noted that the starting and ending dates for the “poppy season” are rather arbitrary. On 31 August ’17, the maintenance yard weather station recorded 0.05 inches of rainfall so that storm was really the first autumn storm and it could be argued that that storm’s 0.05 inches should be added to the seasonal rainfall total but it really only makes a very minor difference. Although the maintenance yard received only 0.05 inches of rain on that last day of August, I believe this was the very edge of a thunderstorm that deposited heavier rain amounts to the east of the Reserve and was the cause for the poppy seed germination that resulted in the early reports of open poppy blossoms at the eastern end of the Reserve’s Lightning Bolt trail and along 110th East. Minor rainfall amounts also recorded that same day at several weather stations located in the foothills of the Tehachapi Mountains support this conclusion.

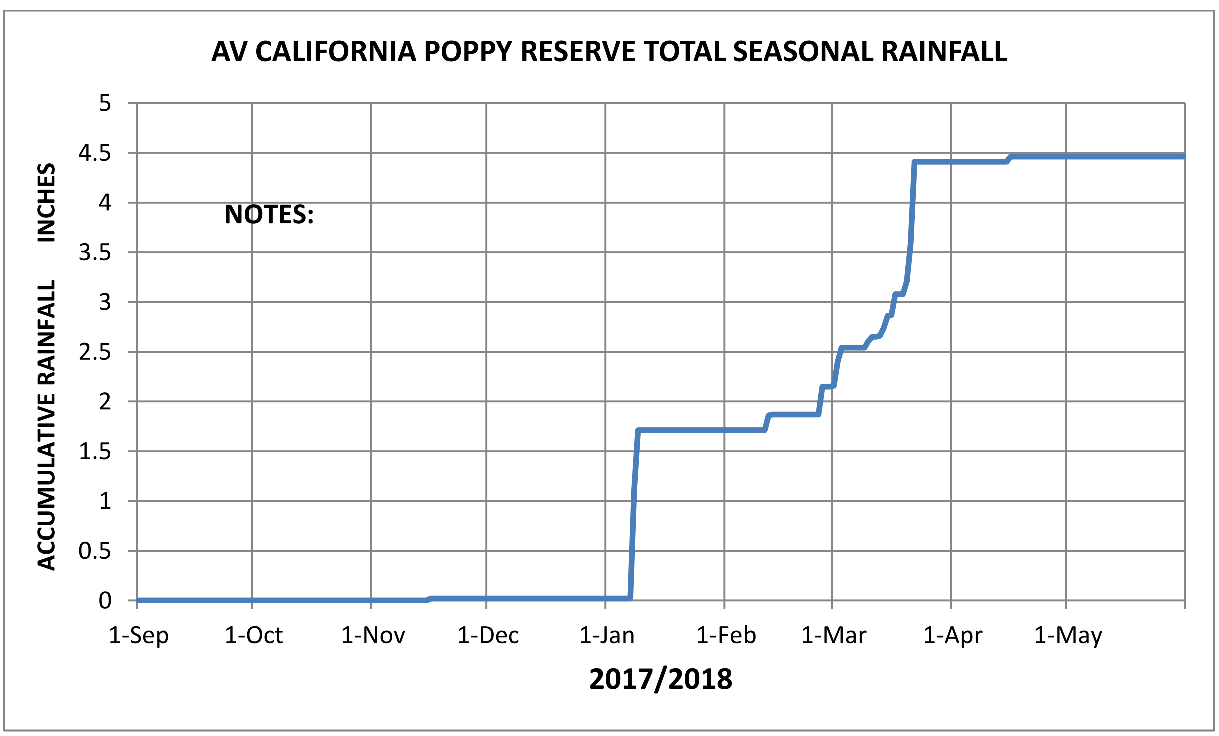

FIGURE 1: POPPY RESERVE RAINSTORMS DURING THE WINTER/SPRING 2017/2018

As noted above, the 4.46 inches of total seasonal rainfall is the fourth driest winter in the last twenty one years; the only years that rainfall data is available for the Poppy Reserve. Only the winters of 2001/02, 2006/07 and 2012/13 were drier; 2012/13 being the driest with a total seasonal rainfall of only 1.4 inches. Based on the rainstorms' recorded amounts, the researchers expected only the 8/9 January storm, and possibly the 20/22 March storm, to trigger any poppy seed germination this winter.

Based on many past years' field observations, the only modest number of poppy seed germination observed following the 8/9 January rainstorm was unexpected. From previous rainstorms data, a large number of seed germination was expected from this storm's almost 1.7 inches rainfall. Figure 2 shows the seed germination trends observed in past winters.

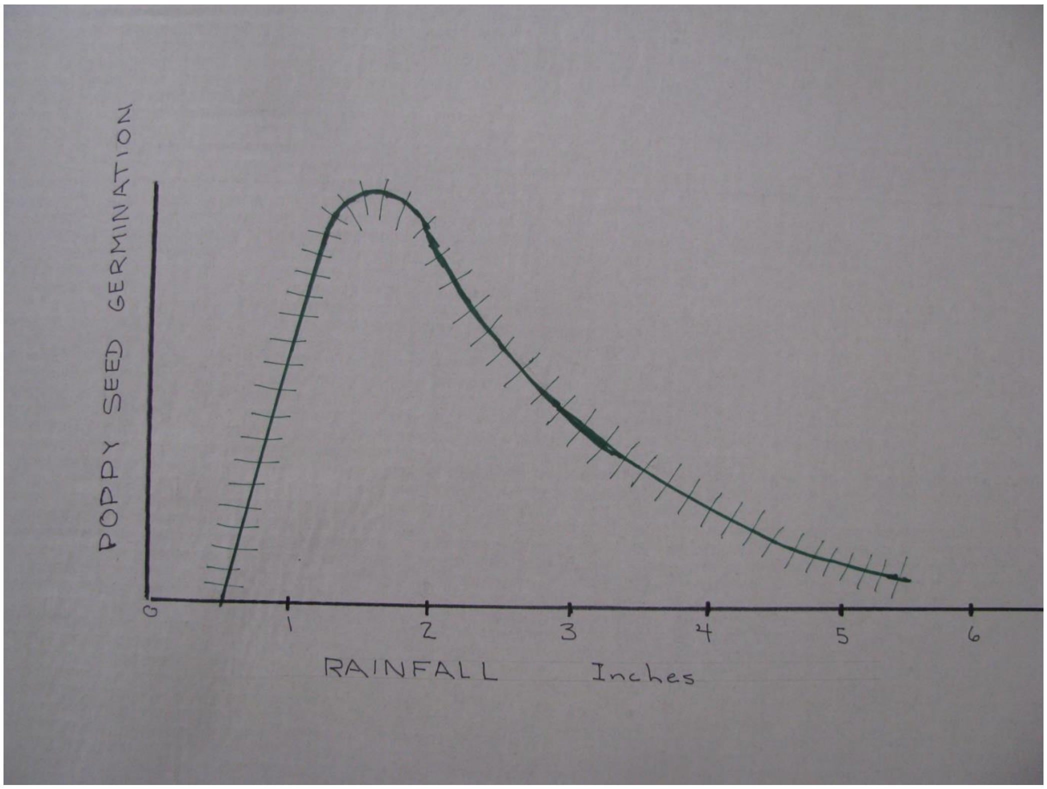

FIGURE 2: POPPY SEED GERMINATION TRENDS WITH RAINFALL AMOUNTS

The figure shows only the observed trends without any seed germination quantities. The collected data is still being analyzed to better define and actually quantify this figure. As mentioned in the text above, little or no seed germination has been observed for rainstorms depositing less than approximately 0.5 to 0.6 inches of rainfall. The maturation process of the soil's dispersed seeds dehydrates the seeds which prevents the seeds' chemical reactions that cause germination. When the soil is adequately moistened from a rainstorm, a small porous opening in the hard, impervious seed shell allows water to enter the seed re-hydrating the seed's interior materials initiating the chemical reactions that begin the germination process. Apparently, rainfalls less than the 0.6 inches lower limit do not adequately re-hydrate the seed and the germination process is not initiated. When the rainfall's observed lower limit is exceeded, the amount of seed germination rapidly increases initially; though this trend does not continue indefinitely. Observations show there is an optimum rainfall amount that results in a maximum amount of seed germination and the number of seeds that germination then starts to decrease for higher amounts of rainfall. The optimum rainfall appears to be somewhere between one and two inches of rain. Upwards of 250 to 300 poppy seeds per square meter (about 20% larger than a square yard) have been observed germinating following a rainstorm with this optimum rainfall. This amount of seed germination alone is adequate for providing outstanding poppy color the following spring; meaning even an outstanding poppy season can come from a single rainstorm if its rainfall amount is right. Few or no newly germinated poppy seedlings have been observed following the handful of rainstorms since the winter of 2003/2004 that have deposited four to six inches of rain on the Reserve; supporting the decreasing trend of the Figure 2 curve. The researchers are still seeking an explanation for why the early January rainstorm resulted in only limited poppy seed germination.

Long time Poppy Reserve volunteers talk of the “Miracle March” season where a March rainstorm was the first rainstorm of the winter/spring and it still resulted in a good, but late, poppy season. Because this legendary season occurred before the “official” weather station was installed in the Reserve’s maintenance yard, there is no rainfall data to confirm that the March storm was truly the first storm of that winter. Of the 20 years since March 1998, there have been major March rainstorms, depositing more than 0.8 inches of rainfall, in ten of those years; 1998, 2000, 2001, 2003, 2005, 2006, 2011, 2012, 2016, and 2018. Although none of these years had no rainfall before their March storms, a few years, 2000, 2012, and 2018, had relatively little rainfall, 3 to 4 ½ inches of rain. If any year could have benefited from a miracle, this March was one and it certainly didn’t happen. I suspect that the rainfall pattern prior to the “Miracle March” was actually more complex than is remembered.

There is even another reason to question the occurrence of a true “Miracle March”. Similar to our efforts following earlier season winter storms, the researchers have actively attempted to detect and document poppy seed germination following a few of the stronger March and April rainstorms where, based on past observations, substantial poppy seed germination would be expected. Although based on only limited observations, the researchers have never observed poppy seed germination following these late seasonal rainstorms leading to the possibility that the dispersed poppy seeds had reentered seed dormancy and did not germinate even when the soil moisture conditions were the same that triggered seed germination earlier in the winter. If this turns out to be true, it is even less likely that the “Miracle March” actually occurred.

If the 2018 wildflower season was not a “March Miracle”, what did happen? A number of event conspired to keep me away from the Reserve during this spring’s peak flowering time so this description is based on feedback I have received from the other researchers, Marsha and Bob. The season pretty much unfolded in line with the researchers’ early season prediction; modest displays with maybe spots of better poppy color and with the best displays on the west side of the Reserve. If anything, the season was worst than I expected. There were few, if any, areas of generalized color. Instead, there were areas with a slightly higher concentration of individual poppy blossoms. The plants were small with only three to five open poppy blossoms. These few open blossoms makes it difficult to obtain the generalized color patterns we so look forward to seeing. Even though the first poppy blossoms were quite late this spring, the season peak occurred early, as early as late March or early April, and then the season was over.

From Figure 3 shown later in this posting, you can see that the winter/spring of 2016/2017 had the first total rainfall exceeding the long term average in six years. In my earlier “Report From The Field” posting covering the quality of last spring’s wildflower season, I discussed that we saw signs last spring that the lingering effects of the deep drought years were finally over. We will have to watch to see if this winter’s limited rainfall will have any carry over effects on the quality of next spring’s poppy displays.

Besides needing one, or two at most, storms with rainfall amounts necessary to trigger large amount of poppy seed germination, good wildflower seasons also need adequate total rainfall as well as the right timing of the storms. The lowest recorded total seasonal rainfall that still resulted in reported outstanding poppy displays has been approximately seven inches. For this amount of rainfall to result in outstanding poppy displays the rainfall pattern, both amounts and timing, likely must be near perfect. Below the seven inch amount, spatial variations in rainfall over the Reserve probably become more important and the displays become spotty with areas of good poppy color and areas with little or no color. Inadequate total rainfall also stunts the growth of the poppy plants so the plants are smaller resulting in fewer open poppy blossoms at any time; decreasing the intensity of the poppy color. Inadequate total rainfall probably also results in a shorter spring wildflower season as the soil dries earlier.

Storm timing is also important. Although the small, just germinated poppy seedlings are amazingly hardy, they still have limits. Field observations have shown that the young poppy seedlings can survive, even thrive, for long periods without additional rainfall following the seed germinating rainstorm but they eventually become stressed and start to wilt and die after approximately four to five weeks; probably depending on the amount of rainfall from the seed germinating storm and the subsequent daily temperatures. Fortunately, this January rainstorm was quite strong so maybe it helped the young poppy seedlings to survive for the five weeks before any additional rain arrived and the at least seven weeks before the late February storm heralded the series of March rainstorms. When one of the researchers' monitoring plots was checked on 10 Feb, seven of the eight poppy seedlings previously located in the plot still appeared healthy and all had developed their first true leaves. Only one poppy seedling appeared missing giving an 87% survival rate and that was four and half weeks after the January rainstorm. This survivable rate is in line with previous observations showing surprisingly low mortality of young poppy plants as long as the rainstorms come frequently enough. The researchers are still in the process of analyzing all of this season's poppy plant survival data so more on this topic will be reported in a later blog.

Daily temperatures are another factor that can affect survival of the young poppy seedlings. Periods of unusually warm days can quickly dry the soil, stunting or killing off the small poppy plants. This effect was seen in the spring of 2004 where the early March daily maximum temperatures were up to 15 to 20 oF above the typical maximum temperatures for that time of year. Although there was a large number of poppy seedlings growing at that time, most simply died and the few that did survive were stunted with only a few subsequent blossoms. The potential for another outstanding poppy season was over. The less than average rainfall that preceding winter could have increased the deadly impact of the high daily temperatures. Fortunately, the daily temperatures were quite normal this past January and February.

Cold temperatures can also be a problem. California poppies are considered a "frost tolerant" plant species. A research paper I came across described how plants can be tolerant to freezing temperatures. It is all in their stem design. The walls of plant stems are not solid structures but are made up of three layers. Plant stem walls are very similar to cardboard in that the stem wall's outer and inner layers are solid but separated by a middle porous layer. This design requires less material but is still stronger than even a solid wall. Each plant cell is filled with water but water has an unique, but problematic, characteristic. Unlike other liquids whose volume decreases with decreasing temperature all the way down to that liquid's particular freezing temperature, water starts to increase in volume a few degrees above its freezing temperature; 32 oF, as we all know. If the cell's water is trapped in the cell, the freezing water can swell and rupture the cell's wall; killing the cell and then the plant. The stem's wall porous middle layer of frost tolerant plants have more open space allowing water within each cell to escape into the open space as its freezing water swells preventing the cell from rupturing. Because the cell's water helps give strength to the cell, the plant's stems will droop as the water is squeezed out but, as the frozen water thaws, the cells re-absorb the escaped water and the stem regains its strength righting itself without any permanent damage. This is what the Reserve's researchers have observed during past winters' "cold snaps". No matter how cold it gets at night, as long as the day time temperatures remain above freezing the small poppy plants might lose a leaf or two but, for all the plants tracked, the plants eventually survive and continue to grow new leaves. If the day time temperatures remain below 32 oF, it is another story; then almost all the plants die but these extreme cold snaps have occurred only once or twice in the last fourteen years. I believe the reason low daytime temperatures are so damaging is because the soil freezes and the plants' roots are unable to collect the plant's needed liquid water. In some areas of the Reserve, it is not uncommon for the night time temperatures to reach as low as 5 or 6 oF, or even colder, but even the poppy plants growing in these areas have no problem surviving as long as it warms up during the day. Fortunately, the sun normally warms the soil well above water's freezing temperature.

This winter's unusually few rainstorms and limited rainfall might prompt one to ask "Well what is normal?" The next several figures will show what has happened at the Reserve, rain wise, over the last 21 years; since the "official" weather station was installed in the maintenance yard. Similar figures were included in an earlier blog posting but they have been updated to include the latest data.

Figure 3 shows all the available data on the total seasonal rainfall starting from the winter/spring of 1997/98.

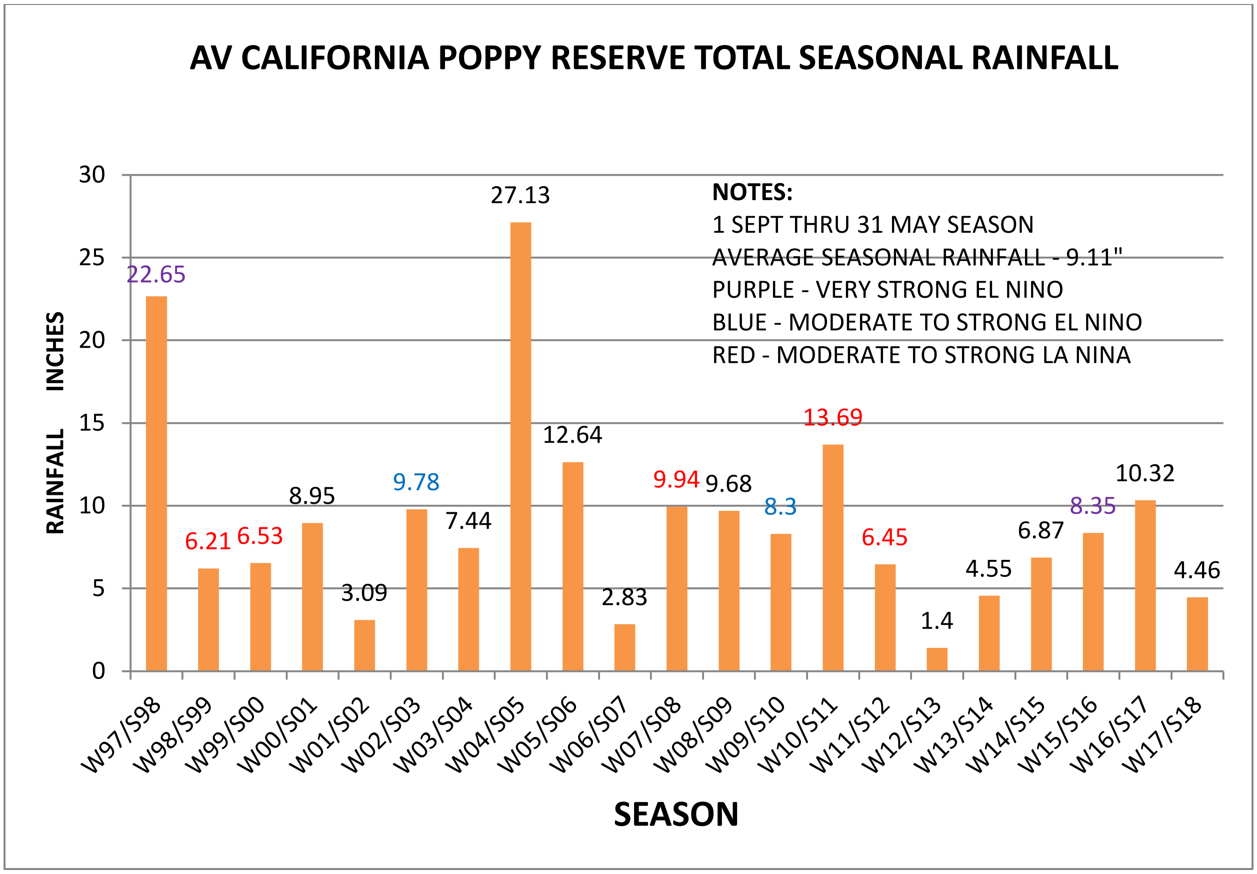

FIGURE 3: POPPY RESERVE SEASONAL TOTAL RAINFALL

Because summer thunderstorms are relatively infrequent near the Reserve, the seasonal rainfall normally matches the yearly total rainfall.

The Figure 3 bar chart clearly shows a wide variation in the Reserve's seasonal rainfall; ranging from a low of 1.4 inches to a maximum of over 27 inches of rainfall. The average seasonal rainfall for these 21 years is 9.11 inches. Keeping Figure 2 in mind, the wettest seasons do not necessarily mean the best spring wildflower displays. The spring with arguably the best poppy displays over this period, 2003, had only slightly over the average rainfall the previous winter. Once the minimum required amount of rainfall occurs, the timing and strength of the individual rainstorms have more influence on the resulting quality of the spring wildflower season. Total rainfall probably does have a substantial impact on the various plant species that do bloom.

There is a lot of talk about the positive or negative impact of El Nino or La Nina winters on the Southern California rainfall patterns. To explore their impact on the Poppy Reserve's seasonal rainfall patterns, the El Nino and La Nina winters that have occurred since 1997 are color coded above the bars. One of the two, 1997/98 and 2015/16, very strong El Nino winters over this period had the second wettest recorded winter but the second year had less than the average rainfall. The two years with moderate to strong El Nino winters had close to the average rainfall; one slightly higher and one slightly lower. At the same time, three of the five La Nina winters did have below average rainfall but the other two years had seasonal rainfalls above the average. In fact, this winter, 2010, was the third wettest season in the last 21 years. The wettest documented winter, having over 27 inches of rainfall, was during a winter with very mild El Nino conditions. Based on the last twenty one years, it appears that El Nino or La Nina conditions contribute very little to explaining the Poppy Reserve's seasonal rainfall patterns.

The same rainfall data is plotted slightly different in Figure 4. Plotting the data this way, a standard mathematical technique can be used to fit a "best" straight line through the data to show any long term trends in the Reserve's seasonal rainfall.

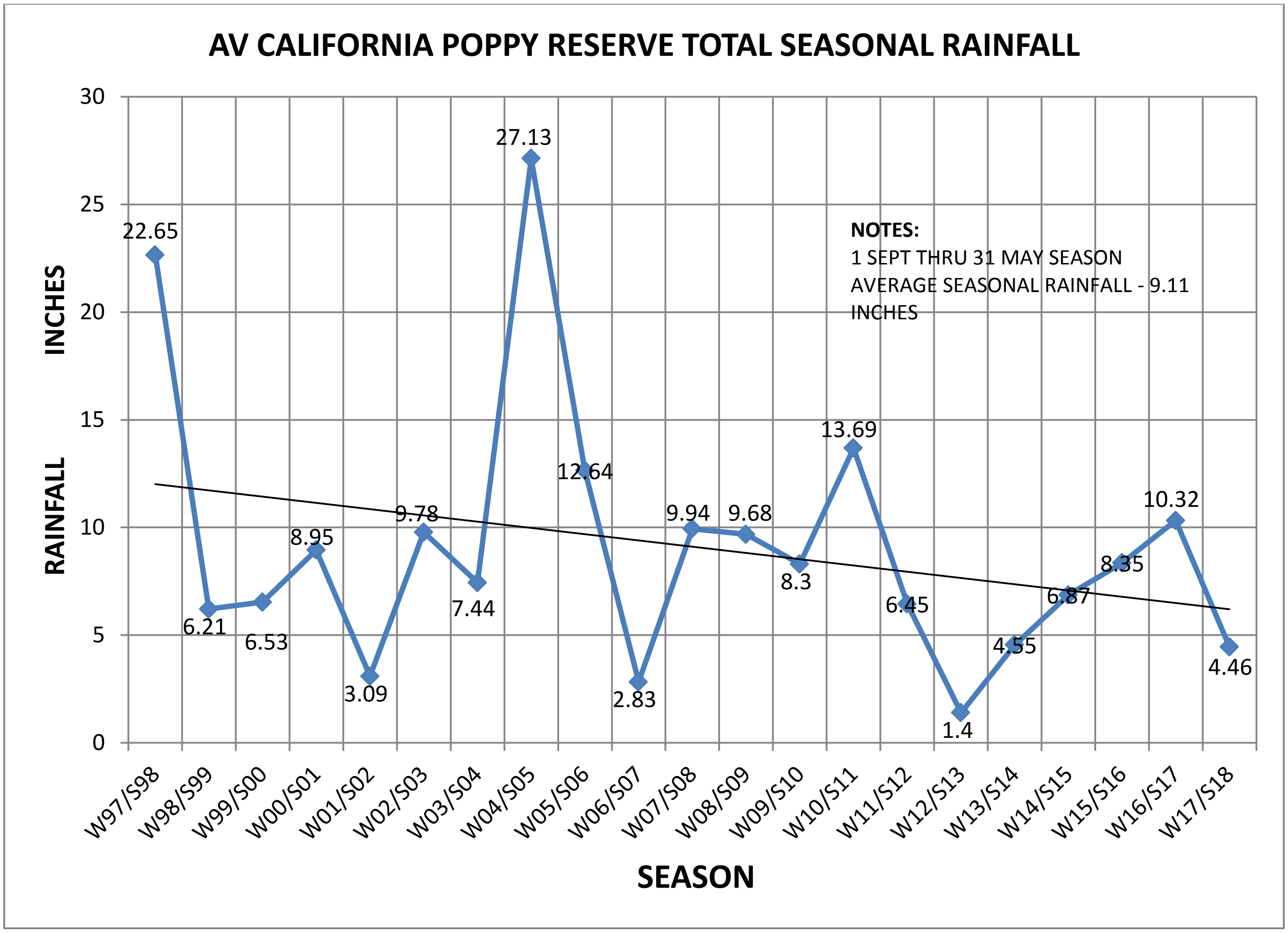

FIGURE 4: POPPY RESERVE SEASONAL TOTAL RAINFALL

Figure 4 shows an apparent decreasing trend in seasonal rainfall since 1997; the Reserve appears to be getting drier. The "best fit line" is showing that the Reserve's late 90's average seasonal rainfall was 11 or 12 inches but in the last few years the Reserve's average rainfall has been only 6 or 7 inches. If this trend is correct, this decrease in seasonal rainfall can be having a significant impact on the quality of the poppy displays as well as changing the Reserve's whole plant and animal bio-communities. With the available data showing at least seven inches of seasonal rainfall is needed for outstanding poppy displays, at least the outstanding spring wildflower seasons will become much less frequent in the future. With the Poppy Reserve located close to the eastern boundary where poppies grow profusely any continued decrease in the long term rainfall would likely move the best poppy displays west of the Reserve.

Because a minimum of 30 years of data is commonly used to determine valid long term climate trends, only collecting future years' seasonal rainfall and including this data in the database will allow it to be determined if the last 21 years is really showing a true long term trend or if the apparent decreasing trend has been caused by the random variability in the Reserve's year to year rainfall. If the trend is real, time will tell if this decrease in seasonal rainfall is permanent, possibly resulting from Global warming, or if we are simply seeing the effect of a very long term climate cycle and the Reserve will eventually return to wetter winters.

There is more information to be mined, and conclusions drawn, from the collected weather data but that will have to wait for a future "Report From The Field" posting.

I end this posting encouraging readers to continue to visit the Poppy Reserve. Except for maybe early in the mornings, the summer months' temperatures can be pretty challenging but the fall months can be very pleasant, moderate temperatures and mild winds, and you can almost always find some type of plant species blooming at any time of the year. I'm not sure you will be so lucky this coming autumn.

If any reader has questions, you are free to email them to me at mfpowell@verizon.net and I am always open to receiving feedback on these postings.