REPORT FROM THE FIELD
JUNE '17

By
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With
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Now that the Reserve's Visitor Center has been closed for several weeks and the 2017 spring wildflower season is drawing to a close, it's time to review what the season actually brought, besides tens of thousands of visitors, how close were my season predictions and some of the results of the volunteer researchers spring efforts. For a variety of reasons, I didn't visit the Reserve as often as intended and, during the times I was able to visit, my efforts were focused on specific tasks collecting data. The end result is that I did not conduct as many "walk abouts" making general observations as I do most springs so my conclusions on the quality of the wildflower displays are somewhat limited. For those readers who did visit the Reserve this spring whose experience was different than mine, any feedback you provide would be greatly appreciated and very valuable in documenting the actual quality of the spring's wildflower displays.

In my previous "Report From The Field" posting, I predicted there would be modest to moderate/good displays of poppies; primarily in the area of the east ridge's Antelope Loop Trails. This prediction was based on general field observations made while walking the various Reserve trails and the moderate number of young poppy plants found growing in the few permanent monitoring plots that have been established across the Poppy Reserve. I would say this prediction was pretty close to what eventually happened. The best displays of poppy color were on the east ridge of the Reserve. Initially, early in the display season, once it finally started in early March, the best color was on the upper reaches of the east ridge between the North Loop of the Antelope Trails, and the Lightning Bolt Trail before moving south to the lower reaches of the ridge, the South Loop of the Antelope Trails, as the season progressed. As these areas started to fade, the best poppy color moved to the south facing slope above the South Loop of the Poppy Trails and that I didn't anticipate. This points out the difficulty of making predictions based on limited data collection. Subtle variations in the Reserve's complex microclimate can have a significant effect on the small-scale quality of the poppy displays; especially when there are moderate poppy displays. I'll touch on the microclimates' variation in rainfall a little later in this posting. Although we walked a number of the Reserve's western trails counting poppy plants along the way, we never had the opportunity to check the South Loop of the Poppy Trail itself. That slope has been an area of good poppy displays in past years so it was not that surprising that it again had somewhat good color. There were two lessons I learned from this spring displays. First and foremost, visitors can be satisfied with even moderate poppy displays if there are at least a few limited areas of good poppy color because they don't have the really outstanding wildflower years for comparison. Secondarily, even "old timers" like myself can also be satisfied by limited areas of good poppy color because the spectacular intensity of the color is so moving. Maybe it was because the last few years have had such poor displays of poppies but I was really touched by this year's displays' radiant beauty.

Although my poppy displays prediction was reasonably good, I wasn't so lucky with my predictions for the other wildflower species, especially for the blue dicks (wild hyacinth), gold fields and slender keel fruit. The large number of blue dick monocots observed early in the season did not result in large numbers of blue dicks blossoms. Even though there were certainly more blue dicks blossoms than seen in most years, there is no way we can claim this was the "year of the wild hyacinth" as I predicted in my last posting. The slender keel fruit displays also didn't meet my expectations, at least on the Reserve's east ridge where I focused my work this spring and where, a few years ago, there were patches of solid bright yellow from the carpet of slender keel fruit. The displays of gold fields were also disappointing, especially on Fremont Butte north of the Reserve whose slopes are normally a brilliant golden. This was particularly unexpected because, with gold fields growing on both the east and west sides of the Antelope Valley, I believe gold field seeds will germinate under a wide range of soil moisture conditions. The other big surprise was the lack of filaree plants this spring. Normally, this invasive species is one of the major competitors to the poppies.

Looking to the other side of the coin, the beavertail cactus plants were covered with blossoms this spring so they gave an impressive display with their brilliant magenta blossoms. It is too late for this season but, I suggest, you would be rewarded by closely observing these blossoms next year. The base of the cup shaped blossoms are filled with pollen and you might think that it is this pot of pollen gold that attracts the many bees seen visiting these blossoms. If you thought this, I believe you are wrong. Watching a blossom long enough to have a bee visit "your" blossom you would see the bee dive into the pollen and completely disappear; like snorkeling in an ocean of pollen. Maybe five to ten seconds later, the bee will reappear; staggering out of the pollen. Covered with pollen, the bee takes off for the next blossom. Although this is a totally wild ash guess, I suspect that the bee is really interested in nectar located at the very bottom of the blossom; beneath the pollen. If true, the bee gets rewarded with a drink of nectar while, incidentally, providing the service of carrying pollen from one plant to another. A service needed for cross-pollination.

During our April 18 visit to the Reserve, the researchers came across a number newly developing plants. Because they had a long monocot similar to blue dicks, I initially thought that somehow a second generation of blue dicks seeds had germinated and were unfolding. Eventually, I changed my interpretation. I now believe they were likely developing golden stars plants. This late spring blooming plant, with its many golden yellow blossoms forming a spectacular umbel sphere maybe 3 inches in diameter at the top of a long single stem, has been found in past years along the eastern side of the North Loop of the Poppy Trails but this spring we found them along the South Loop of the Antelope Trails in surprising numbers as well as at other locations on the Reserve. If you have continued to visit the Reserve after the Visitor Center closed, you might have been rewarded with finding these beautiful plants.

Just a couple of years after first starting my field observations, I happened to come across a plant that I identified as a perennial Apricot Mallow. Even to this day, this is the only plant of this species known to be growing on the Reserve. Being profusely covered with blossoms this spring, it is great to know that this plant seemingly survived the recent drought years with little apparent injury. The linear-leafed goldenbush is another story. Contrary to Ripley Desert Woodlands State Park where this plant species grows in great numbers, only two or three specimens of this perennial bush are known to be growing on the Reserve. At least, the one growing near the Visitor Center appears to be only barely holding on. This bush did have some blossoms this spring but much of the bush now appears dead. It will be interesting to learn if this bush survives in the future.

With some plant species having better displays this spring than in most years and others having disappointing displays, we can postulate what factors might have influenced this spring's mixed displays. Because, after all, it is the Poppy Reserve, the discussion focuses on the poppy displays but the discussion has pertinence to the Reserve's other species also. Although every species has different seed germination and plant growing requirements, which is why every spring wildflower display is unique, there must be a degree of similarity or these specific plant species would not be part of the vegetation community associated with the California poppy. The discussion will cover two interrelated topics: (1) the general, overall quality of the poppy displays and then (2) the variation of displays across the Reserve.

The Poppy Reserve's rainfall history is shown in the figures below for the entire 1 Sept to 31 May season:

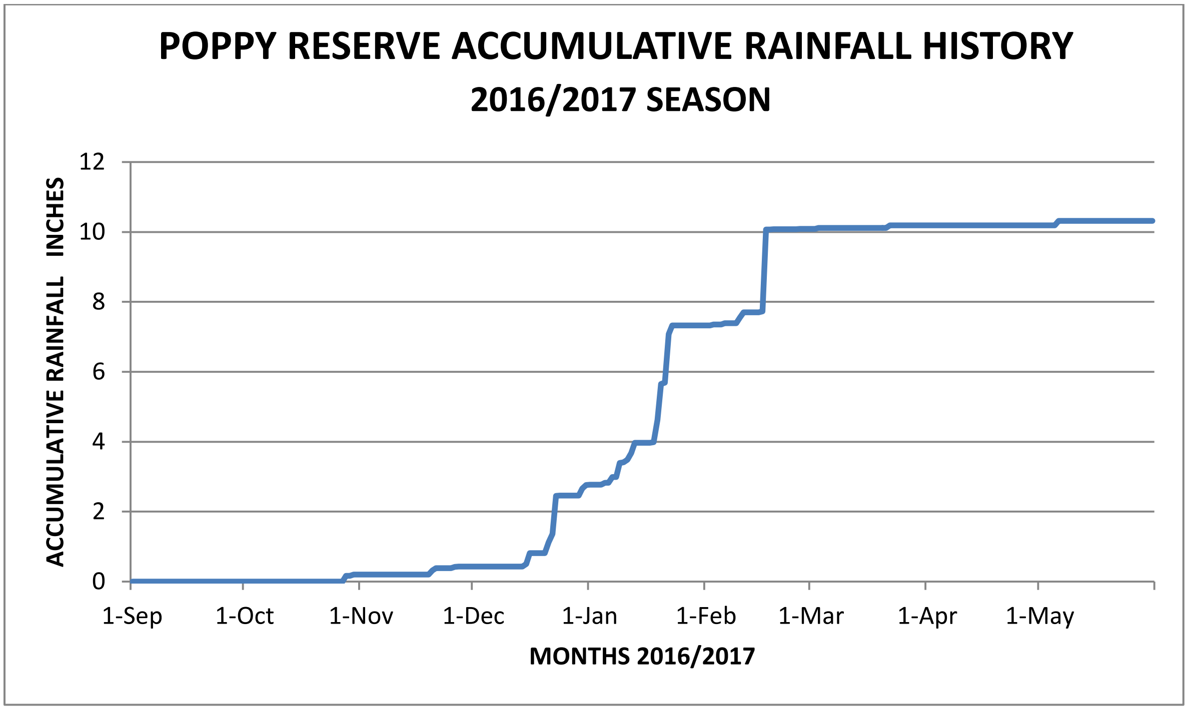

FIGURE 1

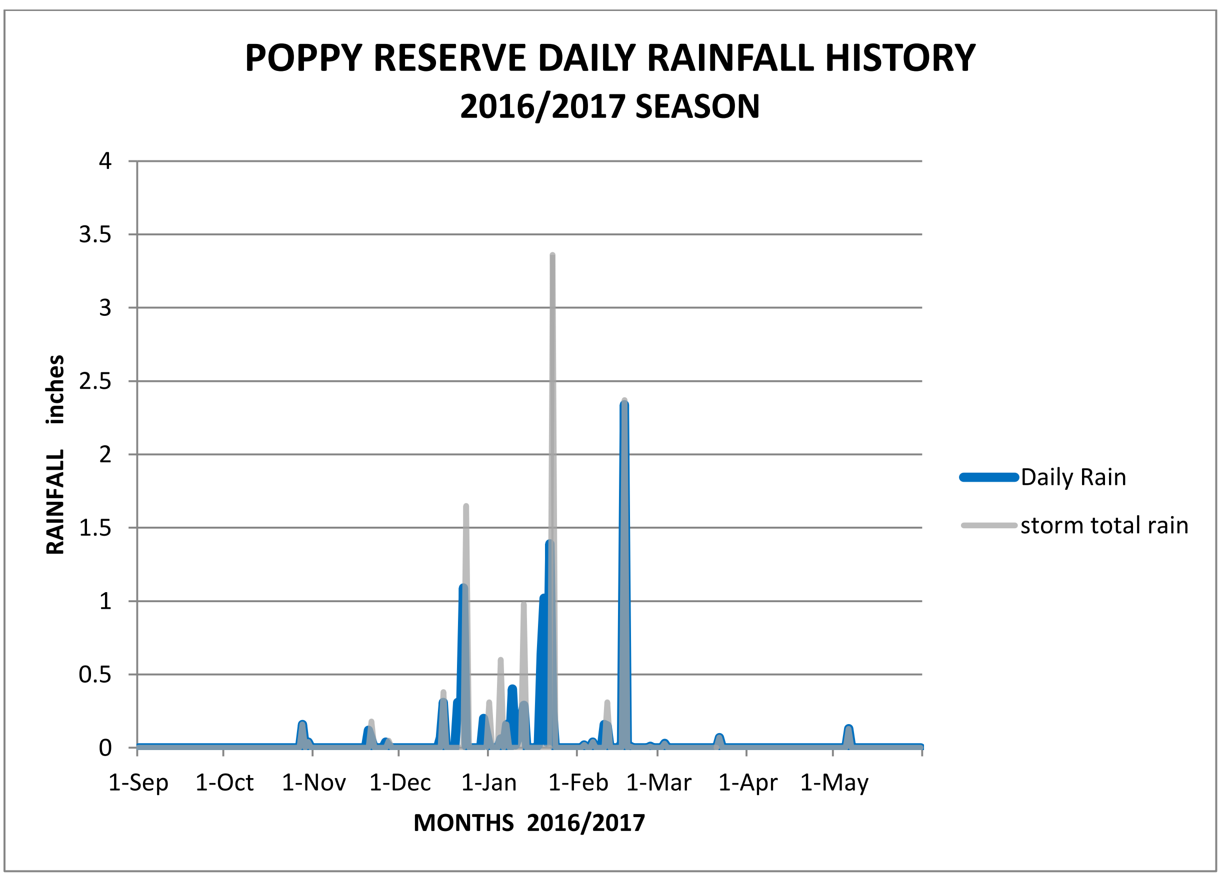

FIGURE 2

The first figure, Accumulative Rainfall, shows that the Reserve's first fall rainstorm occurred at the end of Oct '16 but the true rainy season was only between mid-December to mid-February and that the Reserve received slightly over 10 inches of total rainfall. This is approximately an inch more than the Reserve's average seasonal rainfall of 9.34 inches for the last 20 years. To put it another way, contrary to reports that other wildflower locations throughout California received record rainfalls last winter, the Poppy Reserve received only about ten percent more than average. Ten inches of total rainfall is more than some past seasons received that had outstanding poppy displays so this spring certainly had the potential for being an outstanding season. This brings up the question of "What happened, why not an outstanding season?" I believe the primary answer to that question is in how the total rainfall was delivered. As previously mentioned in my last posting, field observations at the Reserve have shown little, or no, poppy seeds germination following rain storms depositing less than 0.5 or 0.6 inches of rainfall and increasing amounts of seed germination with increasing rainfall above this critical rainfall amount until somewhere between one and two inches of rainfall and then decreasing amounts of poppy seed germination with continuing increasing rainfalls. Although we haven't had an opportunity yet to confirm these field observations through controlled laboratory testing, they make sense for the survival of natural plant populations, especially annual plant species like the California poppy. Every seed that germinates in too dry of soil moisture conditions to result in a high probability for eventual plant maturity and dispersion of the seeds needed for future seasons is a wasted seed that does not contribute to the population's survival. At the other extreme, if a seed needs soil moisture conditions that occur only after very infrequent strong storms with high rainfall to trigger germination, that seed is again possibly wasted because it might not even have an opportunity to germinate before it loses its viability and dies. It would be expected that the gene pool for plants producing seeds that germinate in either too dry of soil or require excessive moist soil would be eliminated from the local plant population and the remaining plants produce seeds that are optimally tailored to the local climatic conditions.

I have gone somewhat afield so back to this season's rainfall at the Reserve. From the first figure, it can be seen that the first fall/winter storm that deposited more than ½ of rainfall didn't occur until min-December '16. Figure 2, Daily Rainfall, better shows the intensity of individual storms. From this figure, it is obvious that only three rainstorm events throughout the entire fall/winter rainy period deposited more than the ½ inch or so of rainfall required to trigger any poppy seed germination. The vast majority of this winter's storms might have added some to the total accumulated rainfall but, likely, did not trigger any significant poppy seed germination.

This past winter's rainfall patterns were somewhat unusual. Most typically, winter rainstorms come from the Gulf of Alaska and each storm's rainy period lasts for only a few hours; maybe eight or less. Figures 1& 2 show that two of this past winter's three poppy seed germinating storms lasted several days. This was because they were atmospheric rivers carrying abundant atmospheric moisture originating near the Hawaiian Islands. In the case of multi-day rainstorms, the daily rainfall does not reflect the maximum soil moisture that occurs as the storm ends. Because there isn't adequate time for the soil to dry, the final maximum soil moisture mostly likely was higher than for a typical single day storm which resulted in reduced seed germination. Therefore a storm total rainfall is also shown in Figure 2; the gray line and is shown on the last day having rainfall. The mid-December storm shows the impact of having multi-day storms. Although the maximum daily rainfall was near the optimum rainfall that results in the maximum seed germination, the storm total rainfall was substantially higher and likely resulted in reduced seed germination. Both the mid-January and mid-February storms likely resulted in even less seed germination because they were "in effect" even stronger. Again, at first glance, the mid-January storm might appear to have near optimum rainfall but there were actually several rainy periods close coupled together.

Besides rainfall patterns, a second factor that has substantially degraded the subsequent poppy displays a few times in the last 20 years has been extreme temperature events. These events have been both extreme cold and extreme warm temperatures. California poppies are known to be a frost tolerant plant species meaning it can survive moderately cold temperatures. This has been repeatedly seen on the Reserve. One of the Reserve's mini-weather stations typically record a few night time temperatures as low as 5 oF, 17 degrees below freezing, each winter. The young poppy plants growing near this weather station might look wilted in the morning but they quickly recover as the air temperature rises. These plants typically lose a leaf or two but every plant tracked has survived and grown and produced blossoms. The times where extremely cold temperatures have killed the young poppy plants were extreme cold snaps where the day time air temperatures have been close to freezing also. In these few cases, the near-surface soil itself has actually frozen and this has resulted in almost universal death of the poppy plants and almost no poppy displays the following spring. There is no indication that this occurred this past winter. Figure 3 shows this winter's maximum daily temperatures since 1 Jan '17 compared to five other representative winters/springs.

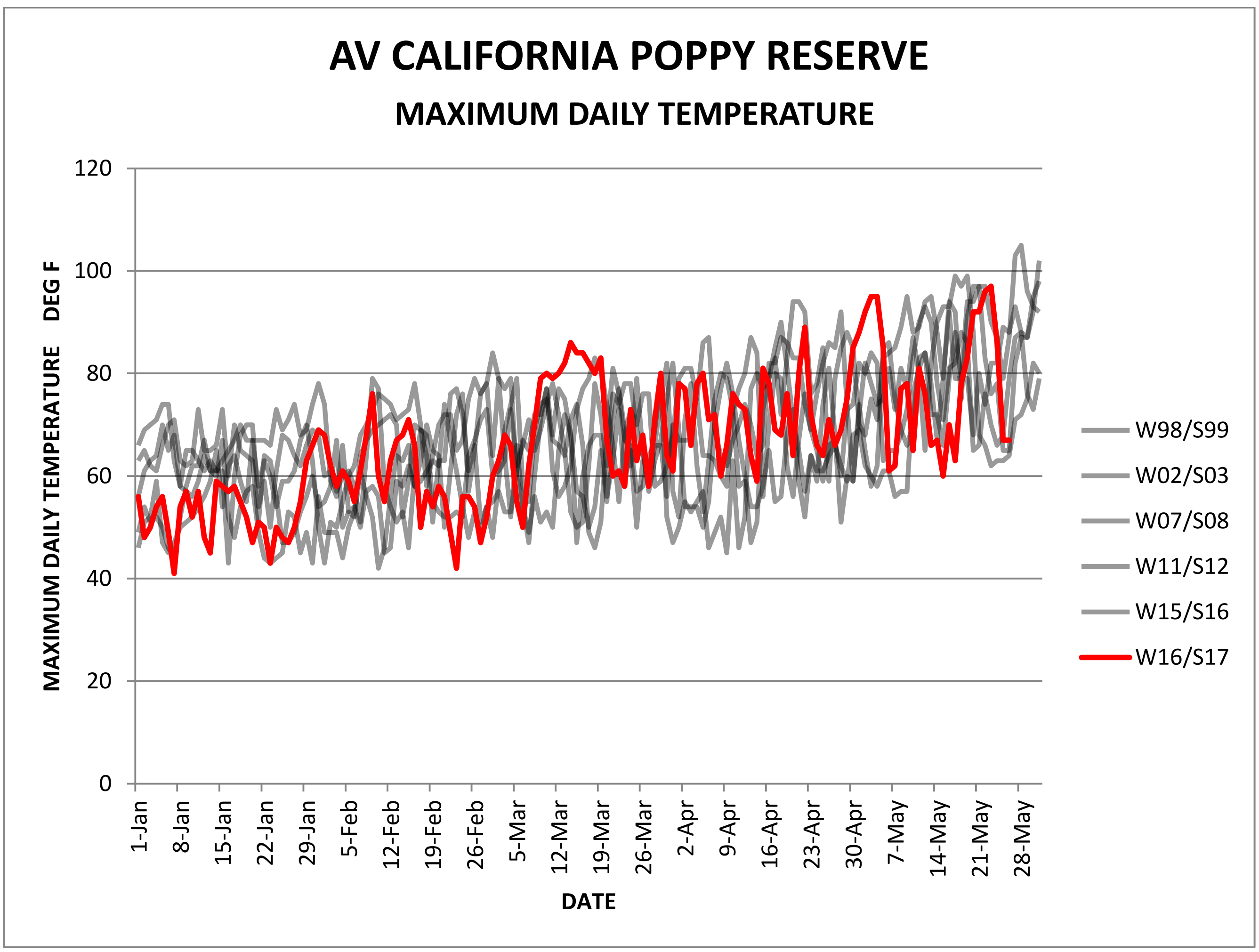

FIGURE 3

Although there were several single days this past winter where the maximum day time temperature was in the low 40's oF, it is clear from the figure that there were no extended extreme cold spells that would have destroyed the young poppy plants.

Extreme warm spells have also substantially impacted the poppy displays. The spring of 2004 is an example. The rainfall patterns that previous winter resulted in a large amount of poppy seed germination. The poppy plant density appeared comparable to the previous spring which had had amazing poppy displays and it looked like the Reserve might have back to back outstanding poppy seasons. That all changed drastically in mid-March when the daily maximum temperatures climbed into the high 80's and low 90's oF for almost two weeks. The more typical daily maximum temperature for that time of the year is in the low to mid 70's. The high daily temperatures caused the near-surface soil to quickly dry resulting in the young poppy plants either dying or, for the few remaining plants, their growth being stunted. The hopes for that season were quickly over. It should be noted that the seasonal accumulated rainfall that year was approximately two inches below the 20 year average and that the first rainstorm with near optimum rainfall did not occur until very late December; both conditions making the young poppy plants particularly susceptible to soil drying that resulted from the extreme high temperatures that did eventually occur.

Figure 3 shows that this spring also had a period of unseasonably warm temperatures in mid-March but both the maximum temperatures and the length of the warm period was much less than in 2004. Although the dates for first poppy seed germination are quite similar between the two years, this spring received almost 2 ½ inches more accumulated rainfall than 2004; likely making soil moisture levels less sensitive to the unseasonably warm periods. This spring's few areas of moderate/good poppy displays argues that the unseasonably warm period in March was not the primary cause for the poor poppy displays. It is expected that effects of warm air temperatures would be fairly uniform across the Reserve and would not leave any large areas unaffected. The Reserve's topography does not appear to result in concentrations of soil moisture where this spring's best poppy displays were observed.

A third possible explanation for this season's only moderate poppy displays was the late first seed germination event. Within the last 20 years, there have been a few times that poppy seeds have germinated following mid-September or mid-October rainstorms. This year the first observed poppy seed germination occurred seven to ten days following the mid-December storm. How can a two or three month delay in the start of the wildflower season affect the quality of the eventual wildflower displays? One possible way is that the younger poppy plants, with less developed roots system, might be more adversely impacted by soil drying resulting from any prolonged spring warm spell. As discussed above, this does not appear to have happened this year.

There's another possible way that the late seed germination could affect the quality of the subsequent poppy displays. This is pure speculation with very little data to support this possibility. With two to three months less time to develop their root system and plant structure, it is possible that the shorter growing period simply results in smaller poppy plants, with fewer open blossoms, compared to years when poppy seed germination occurred earlier in the fall months. Poppy plants inventoried this season had less than half the number of open blossoms on average as the poppy plants inventoried during the 2003 season; a season with outstanding poppy displays. The number of open poppy blossoms per plant is only part of story but does have a direct impact on the poppy display color. Areal plant density, # of plants per unit area, is another key factor influencing the quality of the poppy displays. We are intending to collect data on this year's areal plant density in the coming months to compare with the 2003 data.

In summary, a number of factors, including rainfall and temperature patterns and seed germination dates could be factors that influence the eventual quality of a poppy season's display. It appears that last winter's rainfall patterns led to less than maximum poppy seed germination which, in turn, led ultimately to the degraded poppy displays this season.

A perceptive reader might be posing the question "If the reason for the poorer poppy displays were that the storms were either 'too weak or too strong' why were there several areas of good poppy displays in the Reserve's east ridge region?" Although I believe that the intensities of this winter's storms were a major contributor to the eventual reduced quality of the spring's poppy displays, I have to admit my generalized statement was an over simplification and therefore not fully correct. In truth, other factors also contribute to the variation in localized poppy display quality.

One contributing factor is a variation in local rainfall amounts. The Reserve's complex topography with two west to east running buttes as well flat areas contribute to this variation in localized rainfall. The rainfall values shown in Figures 1 and 2 were obtained from the California Department of Water Resources (CDWR) weather station located in the Reserve's maintenance yard. This fully automated weather station records a variety of weather parameters hourly and the data is accessible through the internet. Although this is the most complete weather information for the Reserve, the recorded data are actually representative of only one spot on the Reserve. To document any variation in localized weather conditions, the volunteer researchers have established mini-weather stations at a six selected sites on the Reserve. Each of our weather stations collects rainfall data but use collection rain gauges rather than the digital rain gauge in the CDWR weather station. These collection rain gauges are simply graduated plastic containers so after each rainstorm a volunteer has to go to the Reserve and visit each mini-weather station, recording the collected rainfall amounts before emptying the gauge, making it ready for the next storm. Due to a number of reasons, it is not always possible for a volunteer (we are, after all, volunteers) to clear our rain gauges following every rainstorm; some winters we do better than others. Table A is the tabulation of this winter's rainfall data. The table shows the dates for the actual rainstorms taken from the CDWR weather station data as well as the dates volunteers obtained rainfall data from our five currently active rain gauges. The CDWR daily data was also summed for sequential rainy days to represent each rainstorm's total rainfall. This data is shown in the table's third column.

TABLE A

AV CALIFORNIA POPPY RESERVE

WEATHER STATIONS' INCREMENTAL RAINFALL

DATE	CDWR W/S DAILY INCREMENTAL RAINFALL INCHES	∑CDWR W/S INCHES	EAST RIDGE W/S INCHES	KIOSK W/S INCHES	MARSHA W/S INCHES	SUNFLOWER W/S INCHES	MARY W/S INCHES
28-Oct	0.16	0.16					
29-Oct	0		0.13	0.15	0.15	0.15	0.17
30-Oct	0.04	0.04					
31-Oct	0		0.05	0.05	0.07	0.06	0.1
20-Nov	0.12						

21-Nov	0.06	0.18					
26-Nov	0.04						
27-Nov	0.01	0.05					
15-Dec	0.07						
16-Dec	0.31	0.38					
21-Dec	0.31						
22-Dec	0.24			0.96	0.98		0.9
23-Dec	1.09						
24-Dec	0.01	1.65					
29-Dec	0		1.65	1	1.15	1.95	1.25
30-Dec	0.2						
31-Dec	0.1						
1-Jan	0.01	0.31					
3-Jan	0		0.3	0.32	0.34	0.36	0.36
5-Jan	0.06	0.06					
7-Jan	0.16	0.16					
8-Jan	0		0.26	0.24	0.24	0.26	0.26
9-Jan	0.4						
10-Jan	0.02						
11-Jan	0.07						
12-Jan	0.2						
13-Jan	0.29	0.98					
17-Jan	0		0.9	0.76	0.92	1.02	
18-Jan	0.02						
19-Jan	0.64						
20-Jan	1.02						
21-Jan	0.04						
22-Jan	1.39						
23-Jan	0.25	3.36					
31-Jan	0		2	2.45	2.7	2.55	3.1
3-Feb	0.02	0.02					
6-Feb	0.04	0.04					
9-Feb	0		0.07	0.08	0.07	0.09	0.07
10-Feb	0.16						
11-Feb	0.15	0.31					
16-Feb	0.03						
17-Feb	2.34	2.37					
19-Feb	0.01	0.01					
25-Feb	0		1.75	2.2	2	2.25	1.9
26-Feb	0.01	0.01					
1-Mar	0			0.01	0.01	0.01	0.01
3-Mar	0.03	0.03					
10-Mar	0		0.02	0.01	0.02	0.02	0.02
22-Mar	0.07	0.07					
24-Mar	0		0.07	0.06	0.06	0.08	0.06
6-May	0.13	0.13					

8-May	0		0.05	0.11	0.11	0.15	0.14

The rainfall amounts obtained from our mini-weather stations were then plotted against the CDWR storm totals for each time period between when volunteers collected our rain gauge data; see Figure 4.

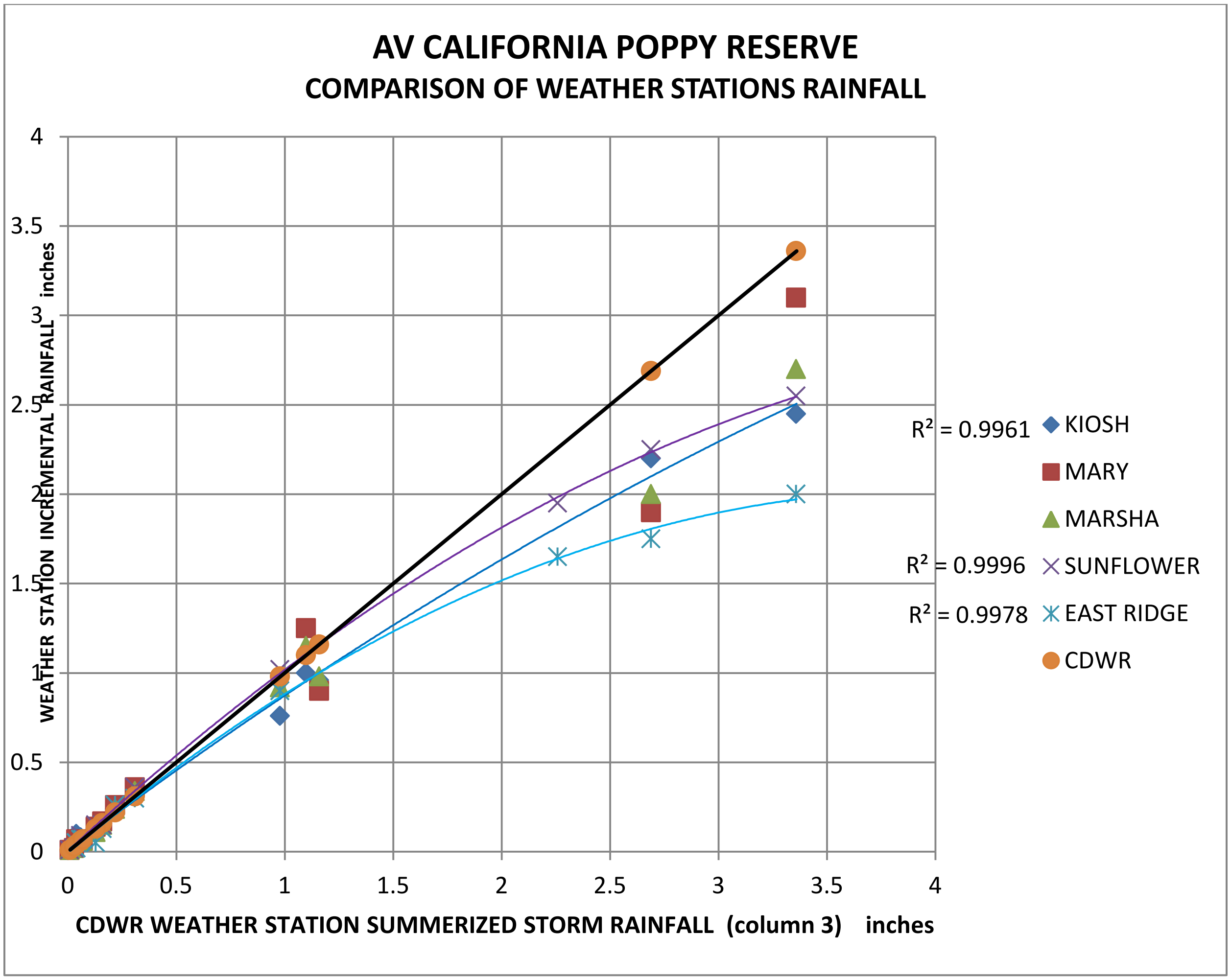

FIGURE 4

Besides the rainfalls for each of the five mini-weather stations, the CDWR weather station recorded rainfalls were plotted against themselves, the orange dots and dark black line. If there was no localized variation in rainfall, all the mini-weather station data would lie along the black line. Because the colored symbols do not lie along the black line shows that there can be a rather substantial variation in the localized rain amount. Using a readily available math technique, “best fit” curves were generated for three of the mini-weather stations’ data; the colored lines. The colored lines show the most likely local rainfall variation for any CDWR rainfall amount. Focusing on the east ridge mini-weather station data, light blue asterisks, gives a good example of how the curves can be useful. As can be seen in Table A, a value of 1.65 inches of rain was recorded for the East Ridge mini-weather station on 29 Dec ’16. That 1.65 inches constitutes the total rainfall from the four separate rainstorms that occurred between 20 Nov and 24 Dec ’16. The CDWR weather station recorded less than ½ inch of rainfall for three of those four storms but, for the 21 to 24 Dec. storm, the maintenance yard received 1.65 inches of rainfall; probably on the high side of the rainfall amount that results in the maximum poppy seed germination. Using the light blue curve on Figure 4, the east ridge region would be expected to have received approximately

1.3 inches of rainfall from that same storm. The same type of analysis can be preformed for the 18 to 23 Jan '17 and 16-17 Feb '17 storms. In all cases, the Reserve's east ridge likely received rainfall amounts that are predicted to result in more poppy seed germination compared to the Maintenance Yard weather station and the western side of the Reserve. What might have been "too much" rainfall at the maintenance yard was, at least, closer to "just right" further east on the Reserve. This variation in rainfall is certainly one plausible explanation for the better poppy displays along the Lightning Bolt and Antelope Trails this spring.

It should be noted that the Kiosk rain gauge is located only a few hundred yards north of the maintenance yard so the large variation between its recorded rainfalls and the CDWR rain gauge data was unexpected. This discrepancy is currently being investigated. A collection rain gauge previously placed just outside the maintenance yard in past years showed good agreement with the CDWR rain gauge data so the unexpected variation is likely not due solely to having two different styles of rain gauges.

It is generally believed by poppy researchers that poppies grow better on south facing slopes. One well known poppy researcher has actually stated that poppies don't grow on north facing slopes. To investigate this claim, one of the Reserve's permanent monitoring plots is located on a north facing slope and has had poppy plants growing in it each year. Therefore the claim that poppies don't grow on north facing slopes is not true. On the other hand, because this plot typically has fewer growing poppy plants than the other monitoring plots, this claim is, possibility, partly true. With the hillside that the Antelope Trails traverse and the hillside north of the Poppy Trail, South Loop (the other area with better poppy displays this spring) both being south facing slopes, their slope orientation could also be a second factor contributing to their better displays.

Even a third explanation for the locations for this spring's better poppy displays could be variations in soil characteristics. The Reserve's complex topography also results in a wide range of soil types. The USDA's soil maps for the Reserve shows this soil type diversity. The influence of variations in soil types on poppy plant growth and displays is still a topic to be explored in the future.

Whoa, this posting has taken on a life of its own; even more so than my previous postings. I haven't even started to discuss the topics I originally planned to cover in this posting. Because some of you readers might also be saying "whoa" this posting is already too long, I'll save the rest for my next posting in three months.

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.

Acknowledgement: I thank both Marsha Neill and Bob Waidner for their assistance in collecting the data necessary to prepare this posting. Marsha, with Bob's assistance, was the primary volunteer who visited the Reserve numerous times throughout the winter and spring hiking the Reserve's many trails to the mini-weather

stations scattered across the Reserve to collect their rainfall data while braving the Reserve's winter temperatures and winds.