REPORT FROM THE FIELD
SEPT '20

By
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With
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Although I have already acknowledged the efforts of my fellow research volunteers Marsha Neill and Bob and Patty Waidner in the most recent PR/MDIA Newsletter, I want to also give credit here to my fellow volunteers for their contributions in preparing this posting. With the COVID-19 "stay at home" orders, I have not been able to visit the Poppy Reserve so the more local volunteers have collected all the data reported on in this posting and that data collecting is not an easy job. Although some of our data recorders have sufficient memory to continue recording data for a year or more before the memory files are filled, others only have the memory capacity to record data for a maximum of seven days requiring someone to actually visit these recorders once a week to manually record the collected data and re-set the memory. For over a year now, Bob and Patty have conscientiously performed this task. While Bob and Patty primarily focus their efforts on the rain gauge and temperature recorder installed at Ripley, Marsha focuses her efforts on the rain gauges scattered across the Poppy Reserve. That is no easy task because it requires her to visit the Reserve a few days following each rainstorm, no matter how much rain has fallen, and hiking to each rain gauge location to record the collected rainfall amount and emptying the gauges so they are ready for whenever the next rainstorm arrives. For this posting, my efforts were limited to analyzing the collected data and preparing this posting.

With the field research effort focused on the Poppy Reserve, I'll start the posting with the rainfall data Marsha has been collecting over the last season. Our rain gauge data collected by Marsha is summarized in Table 1.

TABLE 1: POPPY RESERVE RAINFALL DATA FOR 2019/2020 SEASON

DATE	CDWR DIGITAL RAIN GAUGE	MAINTENANCE YARD RAIN GAUGE	RAIN GAUGE #2	RAIN GAUGE #3	RAIN GAUGE #4	RAIN GAUGE #5	RAIN GAUGE #6	RAIN GAUGE #7
5-Sep	0.01							
20-Nov	0.15							
23-Nov		0.14	0.14	0.15	0.21	0.15	0.17	
27 Nov -1 Dec	2.01*							
2-Dec		1.83*	1.73*	1.56*	1.59*	1.6*	1.78*	
3-4 Dec	1.09							
6-Dec		1.06	1.01	1	1.04	1.03	1.01	
6-7 Dec	0.35							
12-Dec		0.3	0.28	0.27	0.31	0.24	0.27	
22-23 Dec	0.05							
25-27 Dec	2.06*							
30-Dec	0.01							
4-Jan		1.34*	1.67*	1.8*	1.5*	1.26*	1.88*	
16-Jan	0.16							

19-Jan		0.17	0.14	0.16	0.18	0.12	0.16	0.16
20-Jan	0.04							
23-Jan		0.04	0.04	0.03	0.05	0.05	0.06	0.04
22-Feb	0.04							
23-Feb		0.04	0.04	0.03	0.04	0.04	0.05	0.05
10-Mar	0.71							
12-16 Mar	2.13							
20-Mar	0.01							
22-23 Mar	0.42							
25-Mar	0.1							
5-10 Apr	3.2							
15-Apr		3.08	2.98	5.11	5.29	5.38	5.31	5.12
TOTAL	3.11 inches							

***SNOW STORMS**

Although the rain year is typically considered to run from 1 Oct to 30 Sept, we start the Poppy Reserve's wildflower season tracking on 1 September due to a few September rainstorms being strong enough to result in poppy seed germination. We have some limited field observations that give evidence that poppy seeds will even germinate following summer thunder storms but these thunder storms are fairly rare and, with the extended time periods of hot temperatures until the fall rainstorms arrive, these young plants even more rarely survive. We have selected 31 May as the end of the spring wildflower season because the Visitor Center has closed and, in most years, the annual spring wildflowers have largely completed their life cycles by this date.

A California Department of Water Resources, CDWR, weather station is located in the Reserve's maintenance yard This internet accessible weather station, call sign "POP" on the CDWR website, automatically records a number of weather parameters including rainfall, air temperature and wind speed and direction along with a number of other parameters and updates the data listing hourly. The total rainfall recorded by the CDWR weather station for each of this past season's rainstorms is listed in Table 1's column titled "CDWR Digital Rain Gauge". The equivalent rainfall data for each of our collection rain gauges are listed in the Table's subsequent columns. The locations of rain gauges 2 through 7 varies from the middle of the east ridge trail system to southwest and northwest of the western trails as well as in between these extremes.

Several years ago, it became necessary to replace our original collection rain gauges when they started to fail due to the harsh desert conditions. Because we decided to replace the original gauges with a new design used by the Community Collaborative Rain, Hail & Snow (CoCoRAHS), an extensive, national grassroots volunteer network of backyard weather observers, one of the new collection rain gauges was installed as close as possible to the CDWR rain gauge; allowing an almost direct comparison between the digital and collection rain gauge. The data from this rain gauge is listed in the column titled "Maintenance Yard Rain Gauge". Having collected adequate data over the last two years to complete the desired comparison, we had intended to re-locate this rain gauge to extend our network of rain gauges by establishing a new location near the eastern end of the Lightning Bolt trail, until COVID-19 interrupted our plans. As soon as we are able to accomplish this re-location, Marsha's task will become measurable more effort.

The first several figures show the comparison between the CDWR digital rain gauge and our new collection rain gauge located nearby. Figure 1 shows the rain gauges' measured rainfall values plotted directly against each other. This plot is a composite showing data gathered over the last two years; sixteen rainstorms during the 2018/2019 rainy season and eight rainstorms from this past season. Initially, the data for the two seasons were independently plotted but they were so similar that the complete data set was combined for the composite plot. This plot clearly shows how closely the two different rain gauges types agree. A "best fit" linear trend line is also shown in the plot. The close correlation between the two rain gauge types is reflected in the high R^2 value. A R^2 value of 1.0 would mean that the two measured rainfall values agreed perfectly.

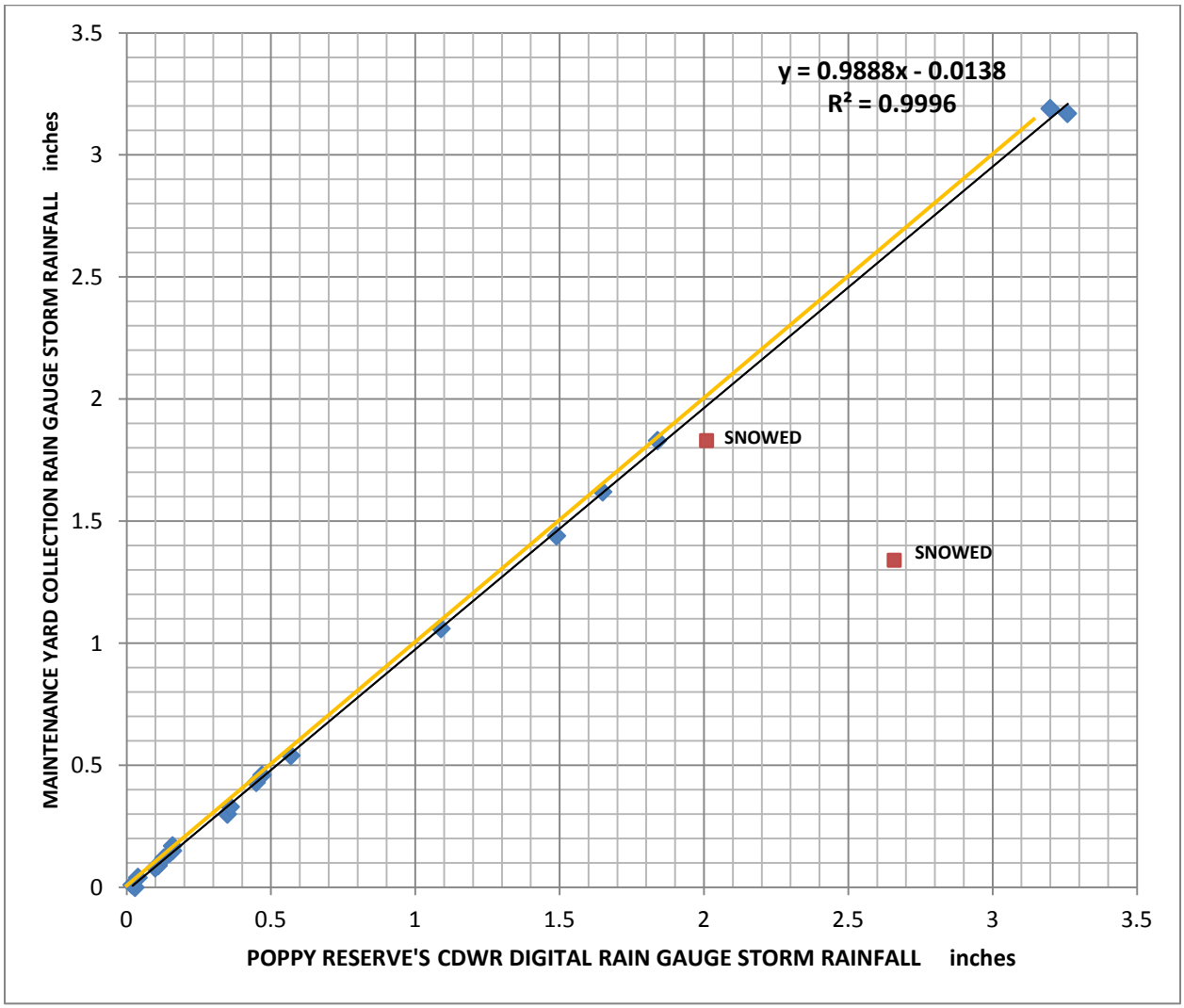


FIGURE 1: MEASURED RAINFALL COMPARISON BETWEEN A CDWR DIGITAL RAIN GAUGE AND A CoCoRAHS COLLECTION RAIN GAUGE

If you look closely at Figure 1, the two rain gauges do not actually perfectly agree; the figure's gold line is a perfect match. Figure 2 shows the differences between the measured rainfall values between the two rain gauges.

On average, the CoCoRAHS rain gauge reads 0.02 inches less than the CDWR digital rain gauge. In addition, there is a random variation between the two types of rain gauges. For approximately

70% of the measurements, this random variation will be ± 0.01 inches or less. For our studies, where we are most interested in rainstorms depositing 0.25 inches of rain or more and the seasonal accumulated rainfall, these small differences in measured rainfall between the two types of rain gauges are insignificant and it was concluded we can compare the measured digital rain gauge amounts directly with our collection rain gauges measurements without having to make any corrections to the collected values. It would only be if someone was interested in studying the smallest measurable rainstorms, 0.01 inches of rainfall, that the measured values would have to be corrected to obtain a valid comparison between the digital and collection rain gauges.

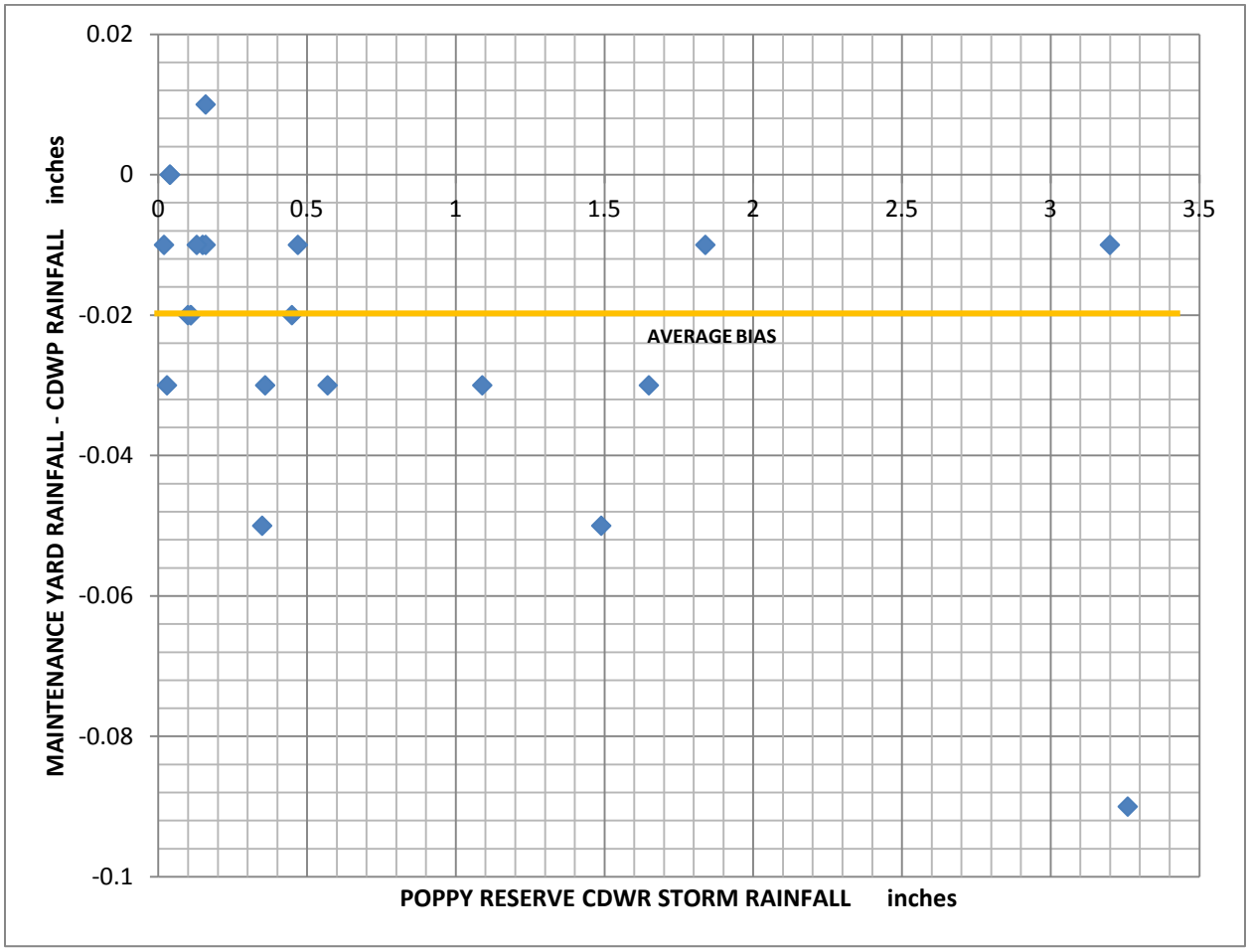


FIGURE 2: DIFFERENCES IN MEASURED RAINFALL BETWEEN A CDWR DIGITAL RAIN GAUGE AND A CoCoRAHS COLLECTION RAIN GAUGE

Unfortunately, much of Marsha's efforts this past season were largely for naught. This is due to the two early season snow storms. Figure 1 show that the precipitation values for two snow storms this past winter are not on the correlation curve formed by the rain storm data. It is pure speculation but our best, really only, hypothesis was that our collection rain gauges filled with snow and then the wind blew away any further accumulating snow. Figure 3 is a view of one of the new rain gauges being installed in the field (the level insures the opening of the gauge is horizontal). The collection cylinder is 4 inches in diameter and approximately 1 inch high before

tapering into a funnel with a small diameter opening supporting the theory that accumulating snow could easily plug the small diameter funnel outlet.

FIGURE 3: CoCoRAHS STYLE RAIN GAUGE INSTALLED AT THE POPPY RESERVE

Although the "wind blowing the snow away" seems like a plausible scenario, the data, unfortunately, doesn't support this hypothesis. During both the Thanksgiving and post-Christmas snow storms, the Poppy Reserve winds were very mild, less than 5 mph, during the most likely times it was actually snowing and, for the Thanksgiving storm, those mild winds continued until after the time Marsha visited the Reserve and emptied our collection rain gauges. The winds did increase to almost 20 mph, with higher speed gusts, shortly after the snowing stopped from the post-Christmas storm but neither snow storms matched the "rain" correlation curve.

If, for whatever reason, our collection rain gauges gave erroneous readings during the snow storms, it is also possible that the CDWR digital rain gauge also gave incorrect readings but we have no direct way to confirm this or not. Although it is approximately twice the size of our collection rain gauges, digital gauges typically have a very similar short cylindrical rain collection section before tapering into a funnel shape. The digital rain measuring mechanism is located at the outlet of the funnel. If our gauges filled with snow, it is possible that the CDWR gauge also filled with snow. It should be noted that, if the CDWR rain gauge did record incorrect amounts of precipitation during the two snow storms, the seasonal accumulated rainfall would be somewhat larger than the currently recorded total of 13.11 inches showed in Table 1.

In investigating the possibility that the CDWR rain gauge did record incorrect amounts of precipitation during the snow storms, the recorded hourly accumulation of rain was plotted for the two snow storms. For both storms, there were no obvious anomalies in the plotted data indicating that the gauge did work correctly during the snow storms. In the digital rain gauge ads that I reviewed, some gauges incorporate heating elements to melt any accumulating snow, hail or freezing rain. It is possible that the gauges CDWR uses do include these heating elements and the Poppy Reserve gauge worked and recorded snowfall, as equivalent rainfall, correctly.

If it wasn't December snow storms, it was COVID-19 in March and April that thwarted Marsha's efforts this year. Due to California's rapid increases in COVID-19 cases, the California Department of Parks and Recreation closed most all the State parks in mid-March. It wasn't until mid-April that Marsha obtained permission to visit the Reserve to retrieve our rain gauge data. As seen in Table 1, there were four major rain storms, and six storms total, during that "shut out" period with a total rainfall of 6.57 inches. Other than losing rainfall data for each individual storm, that should not have been serious problem; the total rainfalls should just sit in the bottom of the gauges waiting until the totals were finally read. To our surprise, when Marsha finally had permission to collect our rain gauge data, the total collected rainfalls were significantly less, by more than 1 inch, than expected based on the 6.57 inches recorded by the CDWR rain gauge. We have confirmed that Rain Gauge #2 and the maintenance yard rain gauge were both emptied in mid-March and late March but are still trying to resolve questions about the recorded rainfalls. Rain Gauges #3 through #7 were never emptied during the "shutout" time period and their readings should be close to the CDWR value. As seen in Figure 3, our rain gauges have an inner cylinder which holds a total of one inch of rain. Any rainfall over one inch overflows the inner cylinder and is contained at the bottom of the larger, outer cylinder. The only way collected rainfall can be lost is by evaporation through the small opening in the collection funnel. With the daily maximum air temperatures varying between the high 50's oF to high 60's oF during the "shutout" period, it seems unlikely that over an inch of the collected water could have evaporated through that small funnel opening during that one month period but we need to test for this. How the collected rainfall was lost is still an open puzzle.

In reviewing Table 1's collection rain gauge data, one might conclude, at first glance, the Poppy Reserve has pretty consistent rainfall patterns for the portion covered by our rain gauge network. Although true, over the years of collecting data we have seen several subtle trends. Rain gauge #3, currently the sole gauge located on the east ridge portion of the Reserve, typically records slightly less rainfall than the more westerly located rain gauges. Rain Gauge #4, located just below a saddle on a ridge forming the head of a broad valley north of the Visitor Center, most often records the highest rainfall of any of our rain gauges. Rain Gauge #7, located on the Reserve's southwestern flats, was installed mid-January of this year so it is too early to determine any historical trends.

If it is in the right rainfall range, even small differences in rainfall may have an unexpectedly large impact on the subsequent wildflower displays. The researchers have observed little, or no, poppy seed germination following rain storms with less than 0.6-0.7 inches of rainfall. Although it is not yet closely defined, we believe rainfalls in the range of 1.2 to 1.5 inches results in the maximum poppy seed germination, with less seed germination at higher rainfalls. At least twice now, we have measured young poppy plant densities of 250 to 300 plants in an area a little more than three feet by three feet. Therefore, in the rainfall range of 0.6 to 1.25 or so inches, a local rainfall variation of even 0.1 or 0.2 inches could result in going from no poppies to over a 100 poppy plants per square meter; going from no poppy displays to really good displays.

The first visit the researchers made to the Poppy Reserve looking for young, recently germinated plants after the past wildflower season started with the 20 Nov. '19 rainstorm was on 19 Dec. '19. From Table 1, the readers can see that by that date, two additional rainstorms and a snow storm had occurred. Because it typically takes a week to ten days for freshly germinated poppy plants to even start to emerge from the soil, the researchers were hoping to be able to distinguish poppy plants that germinated from the early December storms and those that germinated several weeks earlier following the Thanksgiving snow storm. With only 0.15 inches of rainfall, the researchers assume that the 20 Nov. '19 rainstorm did not result in any poppy seed germination.

When looking for recently germinated plants, the researchers spend much of our time down on our hands and knees getting up close and personal with Mother Earth. Figure 4 shows several typical views of what we might observe. Although the researchers have little documentation, the soil moisture conditions are most likely quite different between a snow storm, with the snow slowly melting into the soil over a few days, and a typical rainstorm that moves through the area in a few hours before the soil starts to dry out immediately following the ending of the rain. These differencing soil moisture conditions likely result in different seed germination patterns. Figure 4A is a view of what we can typically find and try to make sense of. I was hoping to mark, and point out to the readers of this posting, different plant species at different stages of development but this photograph is just not large enough to accomplish that. When we enlarged this photograph, we discovered this view is primarily just germinated fiddleneck plants with a few, just germinated filaree plants. In Figure 4B, we were able to distinguish between the two generations of germinations because the older generation had just started to develop their first true leaves. What you are viewing in Figure 4B is primarily the plants' cotyledons. The cotyledon is a part of the seed that first emerges from the soil, following the beginning development of the root system which is the first part of a young plant to develop. Like a battery, the cotyledon provides the developing plant its needed energy until, after several weeks, the plant's first leaves develop and the young plant starts to use photosynthesis to generate its required energy.

Even though the photograph in Figure 4C is not the best quality and the researchers have better quality pictures of the pygmy-leaved lupine's cotyledon available, this photograph was specifically

selected to be shared because it shows a completely different aspect of life on the Reserve; both the competitive and cooperative interactions between the various members making up a bio-community. With plants firmly rooted to the earth, it is easy to be lulled into drawing the conclusion that the natural environment is largely static but the opposite is really the truth; Mother Nature is very dynamic with a multitude of interactions. Running out of both time and page limits, I'll keep this topic for a future posting and limit my comments here that young pygmy-leaved lupine plants were observed growing during the 19 Dec '19 Reserve visit. This rather smallish plant with beautiful, but somehow inconspicuous, blossoms has surprisingly large cotyledons; kidney shaped and, maybe, up to a half an inch long. Figure 4C shows the large green and red cotyledons with the first true leaves at the center. This photograph is unique because it is our first documentation of a cotyledon having been partially eaten by a rodent species. I have not observed this type of early food harvesting before. It is not uncommon to find harvesting of young poppy true leaves but, as I just wrote, that is a topic for a future posting.

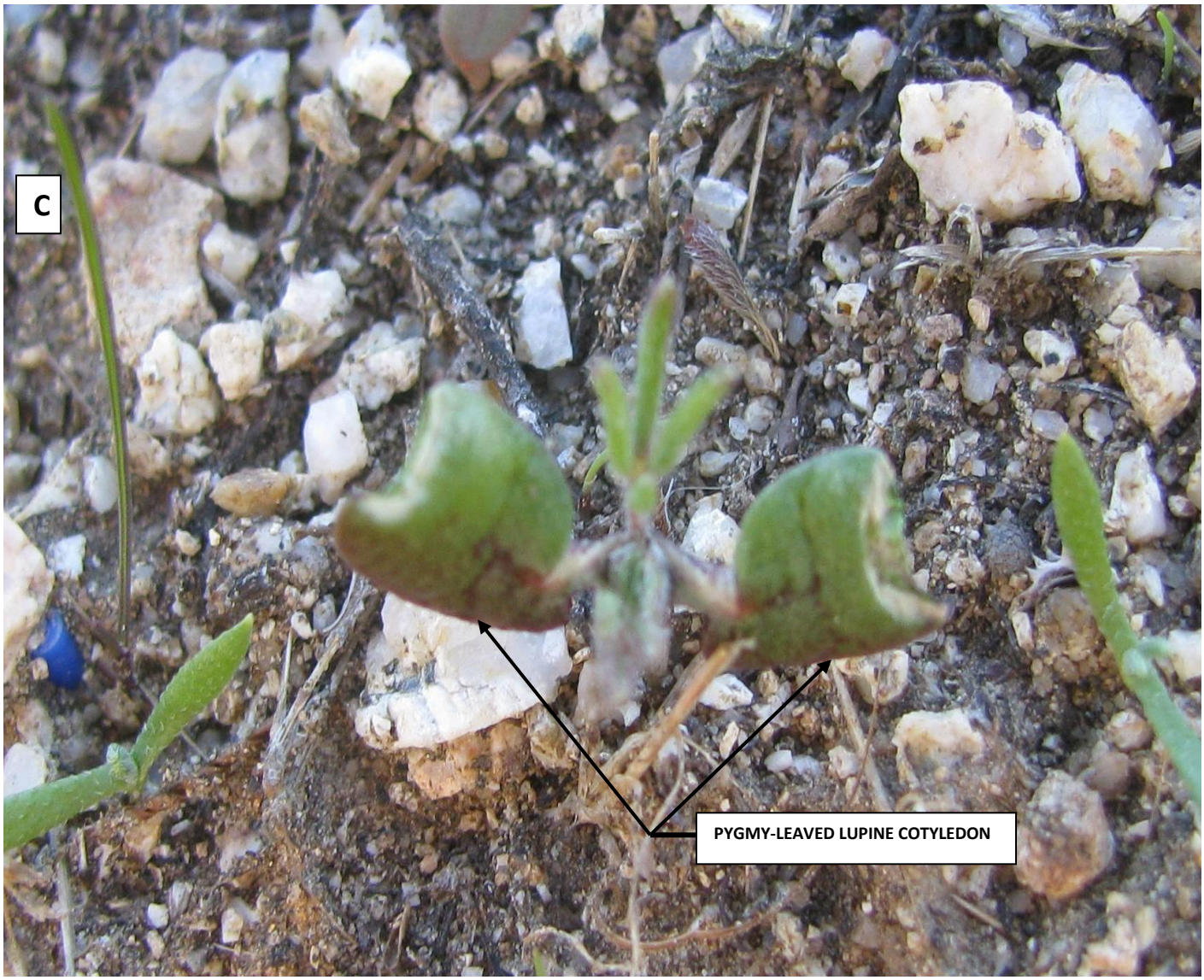
Although not abundant at this time in the winter, a relatively few young poppy plants were also observed during the 19 Dec. visit but not nearly as many as the fiddlenecks. Figure 4D shows how the unique double forked configuration of the poppy dicotyledons appears. Both the gray/green coloration and the unique double fork makes it a little easier to locate the poppy cotyledon but it still takes some practice to locate the first emerged stage of even these plants. Because the plant's center, the primary fork, is hidden beneath some ground litter, it is impossible to determine if this plant's first true leaves have started to develop yet. From the size of this mature cotyledon, the development of the first true leaf pair would be expected soon, if they have not already started to emerge. As a side note, based on the observed maturity, it is most likely that this poppy cotyledon germinated following the Thanksgiving snow storm. With that snow storm's water content of two inches, the few number of poppy plants observed was somewhat surprising. We would normally expect to observe many more poppy plants following a two inch rainstorm than we actually observed during the 19 Dec '19 visit. The reduced number of poppy plants provides support to our suspicion that poppy seed germination patterns are different for snow storms and rainstorms.

Besides the poppy dicotyledons and two young fiddleneck plants, a Blue Dicks, Wild Hyacinth, is also seen in Figure 4D. Although still a flowering plant, this plant species, along with the Reserve's native, perennial bunch grass species as well as the invasive, annual grass species, is in a different class of plants than most of the spring wildflower plant species found growing on the Reserve. Because they have only a single cotyledon, this class is called the monocots, as opposed to the others dicots. In the plant world, monocots would be the "youngest kids on the block" in that monocots are generally considered having evolved from some of the earliest dicot plant species. Personally, I find this unexpected because it seems to me that evolution moves towards complexity and, in some ways, monocots appear to be less complex than dicots. For example, if you pulled up a Blue Dick plant (please don't do this; it is against the law on the Reserve), you would find a ball of shallow roots growing randomly in all directions with no deep tap root associated with the dicot plant species. This seems simpler to me but, maybe, all it says is that monocots first evolved in an environment that had a very consistent rainfall pattern and they didn't need to spend energy growing a deep root system. This certainly doesn't hold for the Poppy Reserve with its wide range of seasonal rainfall totals. It might be interesting to track several Blue Dicks plants to document the rainfalls required to trigger their seed germination and if their lifetimes are noticeably shorter than the other spring wildflower species having deeper roots.

In addition to the differences in their root systems, there are other observable differences between monocots and dicots. One observable difference is the network of veins in the leaves. I'm guessing most of us have admired the network of decreasingly sized veins in plant leaves and seen the similarity with the human blood system of arteries, capillaries, and veins. Like the human blood system, the plant's veins bring needed nutrients and minerals to each cell making up the plant. You don't see that network of veins in monocot plant species. Their veins are typically all straight lines running parallel to each other; a simpler configuration. A third difference between monocots and dicots can be seen in their blossoms. The parts of the blossoms are typically in threes, or multiples of threes; i.e. three, six, etc petals, for example. In contrast, dicot blossoms parts are typically in either four or five, and their multiples. Figure 5 shows this holds for the California poppy; a dicot. Although the researchers have infrequently observed poppy blossoms with only four petals, they most typically have five petals. The four/five rule also holds for the poppy blossom's four stigma; the blossom structure that allows the sperm loaded pollen particles to be transported to the egg filled ovary at the base of the blossom where eggs are fertilized resulting in the development of the blossom's seeds. As seen in Figure 6, this four/five ratio does not seem to hold for the poppy blossom's anthers. The anthers are the part of the blossom's stamen in which the blossom's pollen is grown. When the anthers mature they rupture dispersing the pollen so the poppy pollinators can collect it and transport the pollen particles to another poppy blossom where, if they are deposited on one of that blossom's four stigma, are transported to the ovary and fertilize its eggs. This is called cross fertilization.

The Figure's Blue Dicks' monocotyledon is just starting to grow. It will eventually grow to two to three feet in length before wilting and shriveling up. The blossom stem is the shorter length, smaller diameter stem located next to the monocotyledon. The blossom stem won't further develop until later in the plant's life cycle.


B
C
YOUNGER FIDDLENECK DICOTYLEDON
CHARACTERISTIC THREE LOB FILAREE DICOTYLEDON
FIDDLENECK DICOTYLEDON WITH FIRST TRUE LEAVES AT CENTER


C
PYGMY-LEAVED LUPINE COTYLEDON

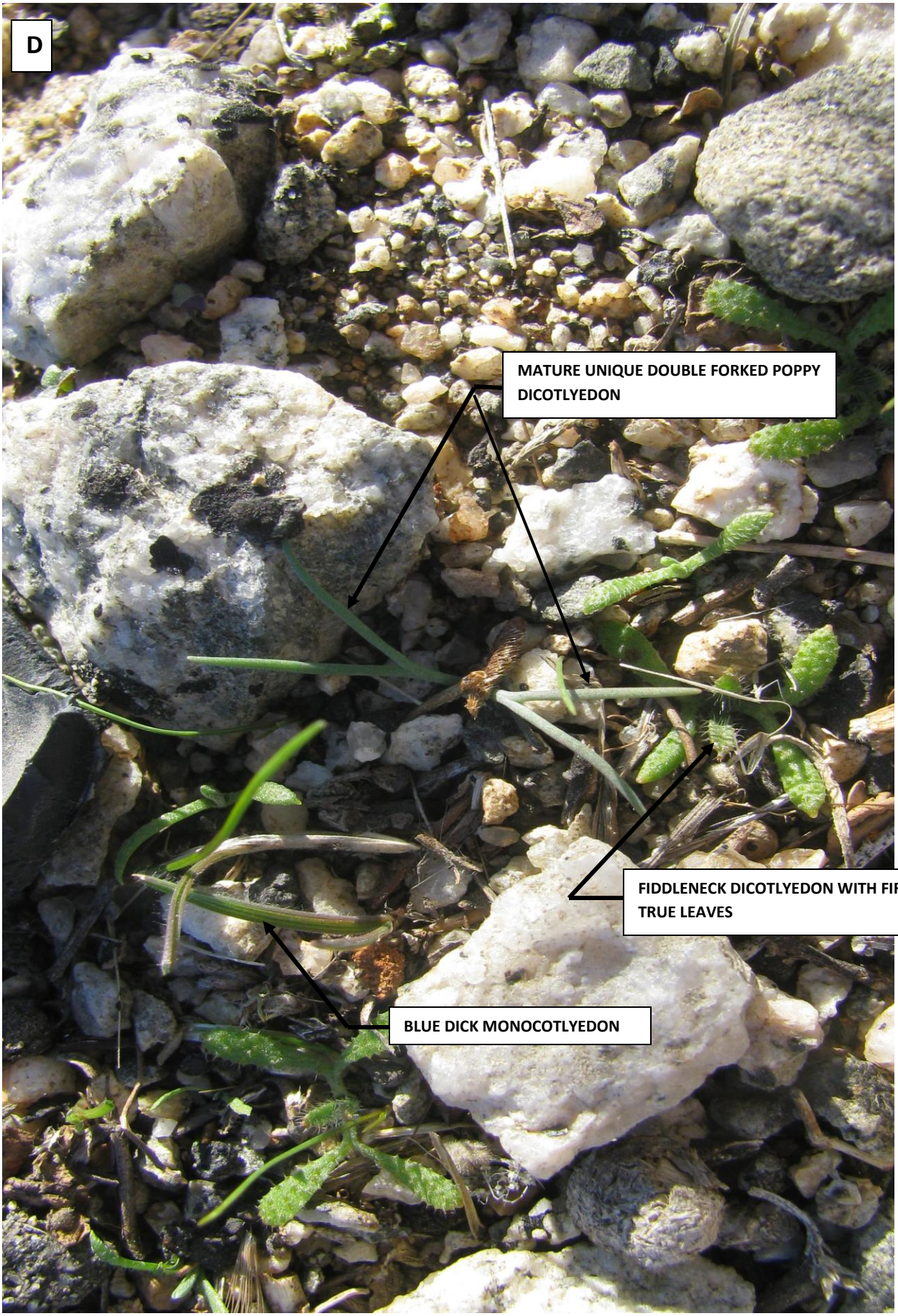


FIGURE 4A,B,C,&D: 2019/2020 WILDFLOWER SEASON'S FIRST EMERGING PLANT SPECIES

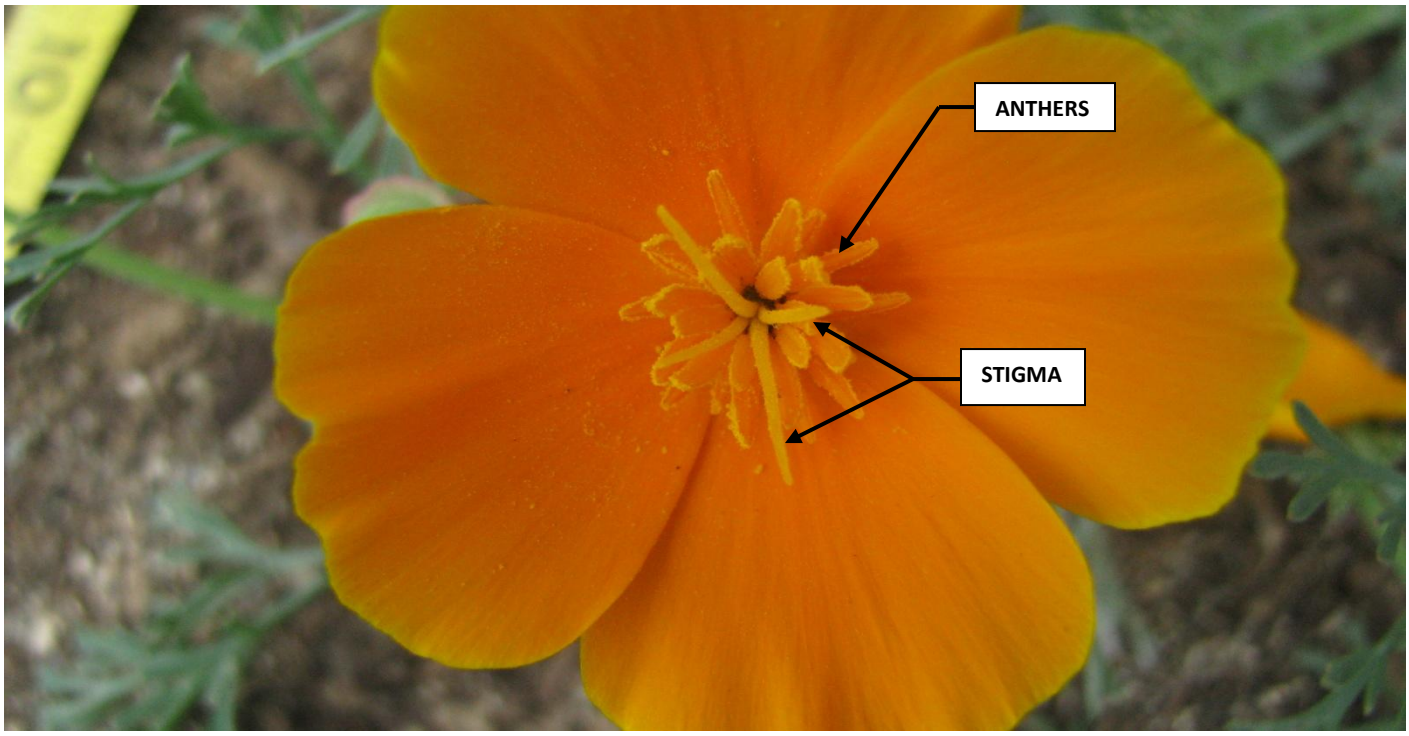


FIGURE 5: CALIFORNIA POPPY BLOSSOM

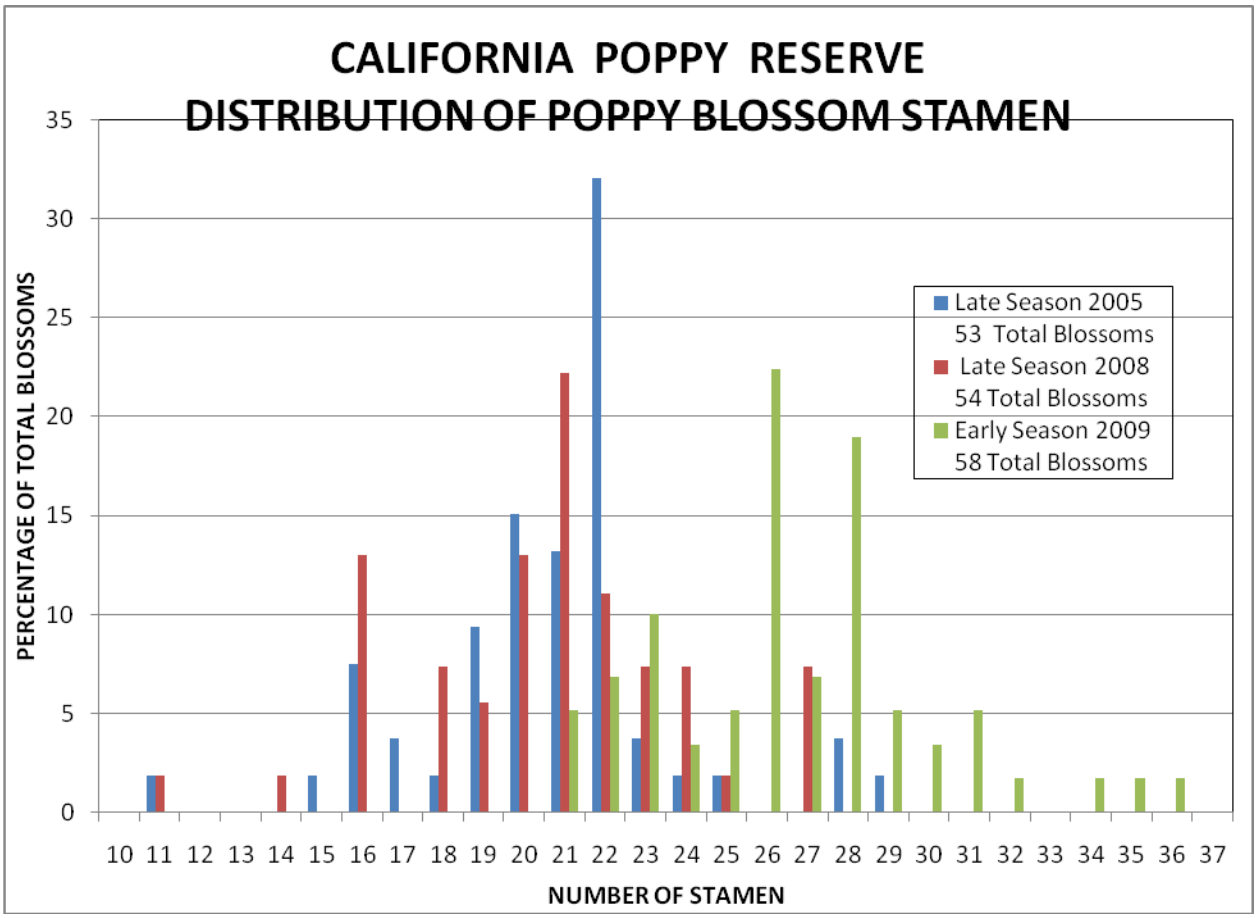


FIGURE 6: CALIFORNIA POPPY STAMEN DISTRIBUTION

Having promised in the PR/MDIA Newsletter just recently sent out to include in this posting a rogues gallery of plant species that you could expect to find if you visit the Poppy Reserve during the "other season" (any time of the year other than the conventional spring season), I started to sort through my photograph files to find appropriate pictures to include. As the list of species went north of 20, I quickly realized that there was no way to include all of them in one posting. As a compromise, I decided to start off with photographs of only a couple species in this posting and continue the gallery in future postings as space allowed. I'll kick off the gallery with Turkey Mullein showed in Figure 7. I know a few of you are probably asking why would I "headline" the gallery with a species having a rather non-descript blossom rather than something more showy like the vinegar weed or desert straw or even one of the multiple buckwheat species growing on the Reserve. The answer is that I wanted to "nip in the bud" a response that the spring season has the impressive "carpet" displays of species like the poppies and goldfields and all the "other season" species are only single plants scattered widely throughout the Reserve. During many years, if you look closely, you will see dense carpets of Turkey Mullein covering much of the Reserve and surrounding countryside; see Figure 8. The blossoms might not be as colorful as the poppies or goldfields but this species provide equally impressive distinctive light gray green carpets of plants.

FIGURE 7: TURKEY MULLEIN – PHOTOGRAPH TAKEN 14 SEPT '17

FIGURE 8: TURKEY MULLEIN – PHOTOGRAPH TAKEN 10 AUGUST '17

Since I have mentioned the vinegar Weed and Buckwheat, I'll show them next; Figures 9 and 10.

FIGURE 9A&B: VINEGAR WEED - PHOTOGRAPHS TAKEN 22 AUG ’19

FIGURE 10: BUCKWHEAT, UNIDENTIFIED SPECIES – PHOTOGRAPH TAKEN 10 AUGUST '17

The last "other season" plant species this posting will highlight might also be unexpected. The history I have read behind this invasive species starts in Russia where it is native. Russian immigrants living in the Dakota's ordered flax seed from the mother country and the seeds of this species came along for the ride. This species became locally established but was limited to the immediate area around where the flax was being grown UNTIL…. It has been years since I read this history account on the UC Berkeley website so the year I am going to now quote might be in error but, I believe, sometime in the 1880's cattle from that same area was put on trains and transported to, HERE IT COMES, Lancaster. This species again hitched a ride and became established in the Antelope Valley where it then spread throughout the western states and became known as Russian thistle or, better known, as tumbleweed. I remember the date this happened was late enough that the "wild west" was pretty well settled by that time so all those classic cowboy movies with tumbleweeds blowing across the desert are all wrong; tumbleweed was still limited to the Dakotas during the hay days of the wild west. Figure 11 shows those "nasty" blossoms that have done all the damage. At the same time, I wonder if any other plant species has had more songs written about it.

FIGURE 11: TUMBLEWEED – PHOTOGRAPH TAKEN 12 OCTOBER '18

When I started to prepare this posting, the original vision was to cover the Poppy Reserve topics in only a few pages with the focus of this posting on the data collected by Bob and Patty at Ripley but here it is many pages later and only now ready to discuss the Ripley data. Like many of the postings, this one took on a life if its own and I was relegated to simply writing where it wanted to go. Being told that the posting is already way, way too long, I'm ending the posting with a couple of Ripley data teasers and a promise to discuss the Ripley data first in the next posting. On a positive note, this will give needed time to analyze more of the Ripley data and, hopefully, install a new temperature recorder at the Poppy Reserve allowing a more definitive comparison of the two State parks environments.

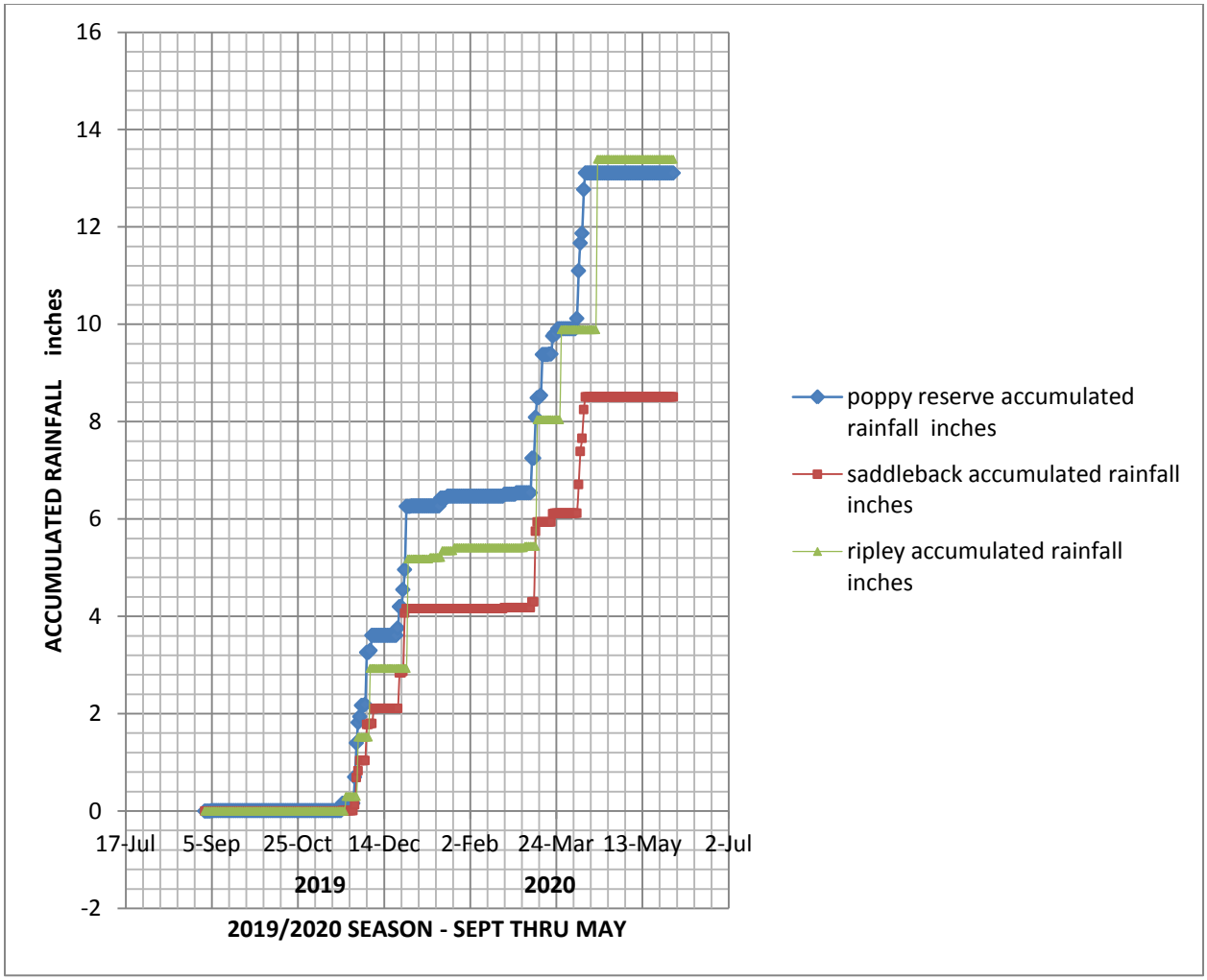


FIGURE 12: ANTELOPE VALLEY STATE PARKS RAINFALL COMPARISON inches

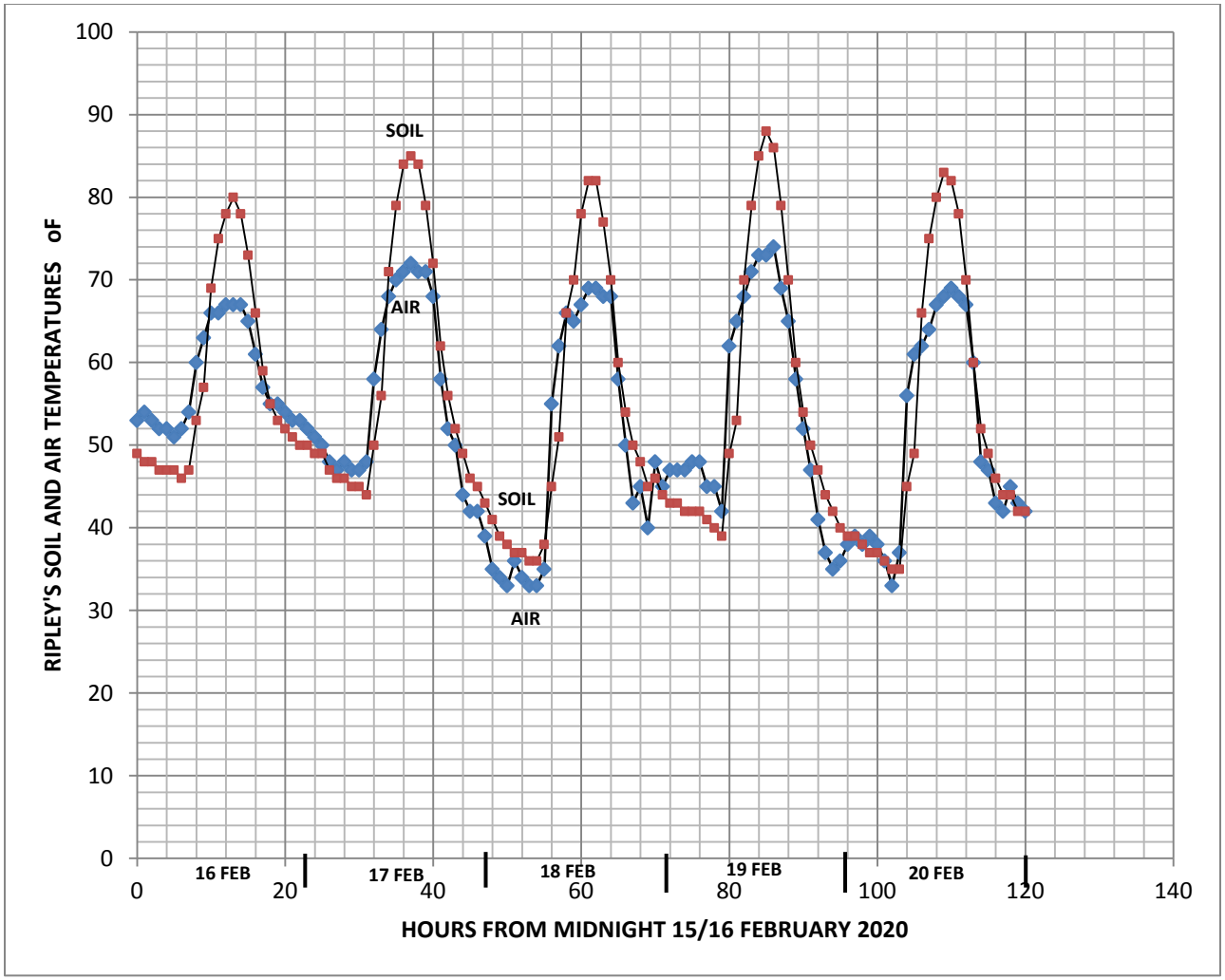


FIGURE 13: RIPLEY SOIL AND AIR TEMPERATURE COMPARISON

As always, I encourage everyone to continue to visit the Reserve throughout the year; only this year, please obey the "social distancing" restrictions. During many years, you can see plant species blooming almost year around. These are different plant species that you don't find during the spring season so you can add to your personal plant list. The autumn months have some of the best weather conditions – reasonable temperatures and mild winds. If you visit early enough, even the summer months can be quite nice.

If you have any questions, comments, corrections, want to add a year to the best poppy display year competition, or simply just want to say "hi", you can contact me at mfpowell@verizon.net. I always enjoy hearing from any readers. May all stay safe and healthy.