As opposed to the lack of young fiddleneck and pygmy-leaved lupine plants, there appeared to be an unusually large amount of young rattlesnake sandmat that seems likely to have germinated as a result of Hilary.

Saving the best for last, yes a limited amount of young poppy plants were also observed, see Figure 8. The limited number of young poppy plants was not unexpected. Actually, it wasn't assured that any poppy plants would be observed. As discussed earlier in this article, the amount of poppy seed germination is depended on the peak soil moisture following a rainstorm. Because decreasing amounts of seed germination has previously been observed following rainstorms depositing more than one and half to two inches of rainfall, it wasn't clear if any poppy seed germination would occur from a rainstorm depositing almost 4.5 inches of rain. Now there is a better sense of the upper limit for poppy seed germination.

FIGURE 8: YOUNG POPPY PLANT ON 6 SEPT '23; MONITORING PLOT M1

For monitoring plot M2, only one poppy plant was located within the boundaries of the $1m^2$ plot; and two additional plants were observed just outside the plot's boundaries. This plot is almost flat with only a slight slope to the north. An estimated 10 to 15 poppy plants are currently growing in monitoring plot M1, which is located on a much steeper, north facing slope. Most typically, monitoring plot M1 has fewer poppy plants than plot M2 but, in this case, the situation is reversed. One possibility is that there was a significant amount of rain runoff for the higher sloped monitoring plot M1, which could have reduced the peak soil moisture level. Because Hilary's rainfall was above the optimum values, this reduction in soil moisture would increase the amount of the expected poppy seed germination. Unfortunately, there is no data to support, or refute, this possibility.

With the primary focus of this article on the competition between different generations of older filaree and fiddleneck plants against younger poppy plants, it might be worth noting the differences in size and development between the poppy plant in Figure 8 and the surrounding filaree plants; plants that had to have all germinated following the Hilary rainstorm. The poppy plant is just starting to develop its first true leaves where the filaree plants have well formed multiple true leaves and are much larger.

Unless the Reserve receives several closely spaced, early season rainstorms, it seems highly likely that the poppy plants currently growing will eventually face total mortality but the soil's large water reservoir could delay their die-off. The current poppy plants have 17.2 inches of rainfall from last winter/spring plus 4.3 inches from the Hilary storm for a total of 21.5 inches to draw on in their bid for survival. In contrast, poppy plants growing during the same period last year had only 7.1 inches, from the previous winter, plus 0.8 inches, from the seed germinating storm, for a total of less than 8 inches of total rainfall to draw on. At the same time, the current

poppy plants are competing for water with the large number of growing filaree plants which are also draining the soil's water reservoir. Only time will tell as the season progresses.

What will be the impact of the Hilary rainstorm on next spring's wildflower season? Clearly, it is too early to make any reasonable prediction; a lot will still happen. One key is when will the next rainstorm happen. If it is a late enough start to our traditional winter/spring season, it's possible that the currently growing filaree plants will die off before any following storm and Hurricane Hilary will have little direct impact on next spring's wildflower season. There might even then be a benefit from this large, selective germination of filaree seeds. If the current large number of filaree plants do die off, their seeds have been eliminated from the soil's seed bank without any significant replenishment. This selective seed bank depletion could give a competitive advantage to the poppies and other native wildflower species.

If the current filaree plants survive until the next rainstorm, it could likely then be a repeat of this past season because the large, mature filaree plants will adversely impact the future poppy seed germination and subsequent plant growth. In this case, because filaree seeds will be predominately being added to the existing seed bank, this advantage will carry forth into the future years. With the Hilary's four inches of rainfall being added to last season's seventeen inches, the soil should be quite moisture giving the small filaree plants plenty of moisture to draw upon; allowing the existing filaree plants to survive for a longer than typical period. Stay tuned; again only time to tell!!!

The large amount of filaree seed germination resulting from the Hilary storm's 4.3 inches of rainfall is a strong indicator that filaree seed sensitivity to peak soil moisture levels is uniquely different to, at least, the poppies, fiddleneck, and pygmy-leaved lupine characteristics and, possibility, other native plant species as well. This observation is certainly worthy for conducting an independent investigation to confirm this and raises the question "Why is the filaree seed germination pattern so different from the Reserve's other plant species?".

Two possible explanations will be discussed. Unfortunately, both of these possible explanations are again largely speculative with little observational data to confirm but both are plausible and need further exploration. Both possible scenarios are based on the assumption that the seeds' consistent pattern of germination sensitivity to varying amounts of rainfall is genetically controlled. The seeds from a wild plant population likely have a variation in the germination triggering gene. Although each seed will germinate under only a narrow range of soil moistures, the population, as a whole, will provide some level of seed germination over a wide range of rainfalls. Because a specific location's rainfall patterns can be quite variable, this gene variability is maintained in that it enhances the probability for the population's survival; it adapts a wild plant population to its specific climate conditions. For example, if a poppy seed had a gene that triggers germination after a rainstorm depositing only a quarter inch of rainfall, the resulting soil is so dry it is likely the young resulting plant would not survive until the next rainstorm added more soil moisture. Therefore that variation of the gene would be quickly eliminated. At the other extreme, if a seed had a gene variation that triggers germination following a rainstorm depositing five inches of rain, it might also be eliminated if the seed's life duration in the soil is less than the typical time span between these extreme rainstorms; i.e. these dispersed seeds wouldn't germinate because they have lost their viability before a germination triggering rainstorm occurs. Clearly, the range of acceptable gene variations is directly dependent on the climate characteristics of the location where the plant population is located, the soil characteristics and the life span of the dispersed seeds.

Comparing the germination characteristics of commercially grown poppy seeds with native seeds provides some indirect support for this gene variability hypnosis. Some poppy seed growers guarantee at least 95% of their commercially sold seeds will germinate while poppy researchers typically report germination yields of only 10 to 20% when they test wild poppy seeds. A commercial grower can achieve these high germination yields, even if they start with a selection of wild poppy seeds, by collecting the seeds from the poppy plants that grew from the original germinated seeds and resowing them. While it is likely that only a small portion of that first generation of sowed seeds germinate (only that portion of the sowed seeds that are naturally matched to the soil moisture level resulting from the grower's selected watering schedule), the natural gene variability would slowly be eliminated by selective germination during the subsequent cycles of resowing while maintaining the same watering schedule until the desired 95% seed germination is achieved.

For their germination testing, researchers typically place a selection of tested seeds on some type of substrate material before wetting the seeds and substrate. This methodology exposes the seeds to one specific equivalent soil moisture level. Therefore, only a portion of the tested seeds would be expected to germinate.

The combination of the beneficial ramifications from multiple resowing cycles and the researcher's single specific watering seem to explain the large discrepancy between the commercial and wild seed germination yields.

Finally getting back to discussing two candidate reasons for filaree seeds seemingly unique ability to have significant germination following locally extreme rainstorms. A first possible explanation is that the non-native filaree seeds continue to have their original germination triggering gene without any changes caused by gene mutations. This explanation is possible but seems unlikely for several reasons. First, because it is widely considered that the filaree species is native to the east Atlantic ocean island archipelagos (including the Azores and the Canary Islands), north and northeast Africa, and southeast Europe north of the Black sea before stretching eastward through the steppes, its native lands don't appear to be conducive for frequent strong rainstorms but this needs additional research. Secondly, because it has been reported that filaree plant remnants have been found in original adobe bricks used to construct California's early Spanish missions, it appears that filaree plants were established in southern California shortly after the first Spanish immigration into the region so filaree has had more than 200 years (200 generations) for the filaree seed's germination triggering gene to mutate as the species adapts to the southern California climate.

A second possible explanation for the filaree seed germination pattern is that dispersed filaree seeds have a significantly long period of viability in the soil compared to its native competing plant species and, therefore, can gain a competitive advantage by having stronger storms trigger significant seed germination. A quick literature search on how long filaree seeds stay viable buried in the soil gave limited and conflicting results. A UC Master Gardener website posting states that filaree seeds stay viable for only "one to three years". In contrast, the UC Davis Weed Control Handbook states that these seeds can stay viable for "many years". No data on filaree seed viability was found on the internet based USDA-NRCS Plants Database. If they have not already been conducted, seed bank viability tests with filaree seeds seem worthwhile doing to determine if this possible explanation is valid but this type of testing could take up to four or five years or "many years".

The truth is the reason why strong storms have the ability to trigger filaree seed germination is a complete mystery. It could be either scenario discussed or, more likely, something totally different. Our observation of the large amount of filaree seed germination post the Hilary rainstorm uncovers a hitherto unknown layer of complexity on how the Reserve's plant community maintains its equilibrium balance and that is pretty awesome. The observation is also a strong motivator to collect filaree seeds next spring for conducting laboratory germination tests to document the filaree seed's germination yield profile. Look for that in a future article posting.

I frequently end these posted articles encouraging the readers to visit the Poppy Reserve during the non-peak season period. Although there aren't the same brilliant wildflower displays during these periods, the quietude and serenity is better and the visitor can find open blossoms almost every month in many years. The autumn can be particularly nice with moderate temperatures and calmer winds. This autumn might be a specially good time to visit. With 17 inches of rain from the autumn/winter/spring rainstorms and the recent additional four inches from the remnant of Hurricane Hilary, this autumn is likely to be a particularly special fall. As a reward to the readers who have read this far, a couple of autumn blooming plant species that have not already been discussed. First, a cluster of sunflower plants located near the long wooden bridge on the North Poppy Loop trail is currently having a nice blossom display. Secondly, the tentatively identified false aster plants are just starting to bloom. They are certainly more numerous than typical and they are taller, more vibrant looking, and covered with blossom buds. Once in full bloom, the two inch diameter, bright yellow blossoms should add to the autumn show with their combination of ray petals and cones.