Our Sand Hill Road
A Prototypical Post-Disturbance System

April 2009

This slope of fine sand was once overwhelmed with cat's ear. Before that it was broom. As the natives repopulated, the area became a complex mix of native groundcovers. In this spot, the more commonly represented plants are *Filago californicia,* clovers (3), miner's lettuce (2), tarweeds (2), *Sagina* (2), miniature lupine, *Camissonia* (2), stonecrop, red maids, fairy mist, lotuses (3), cottonweed, popcorn flower, cudweeds (2), *Navarettia* (2), and not a few more, totaling about 26 natives and 15 weed species.

Wildergarten 5.4

This book was originally produced under the name *The Responsible Party* for which there were two revisions, 1.0 & 2.0. Major revisions are for complete rewrites. Decimal revisions are for revised chapters or navigational changes and are not archived. Back revs are viewable by the numbered links below.

Revision History 1.0 2.0 3.0 3.1 3.2 3.3 3.4 3.5 4.0 4.1 4.2 4.3 4.7 5.2 5.4

Vande Pol, Mark Edward, 1954 –

Other writings by Mark Edward Vande Pol:

Natural Process: That Environmental Laws May Serve the Laws of Nature, ©Wildergarten Press, 2001, 454pp, ISBN: 0-9711793-0-1, LOC Control #2001092201.

Shemitta: For the Land is Mine: ©Wildergarten Press, 2009. Contains: 217pp text, 980pp overall, 14 picture books, 2 tables, 963 photographs, 9 maps, 2 drawings, 2 charts, 145 footnotes, 358 citations, and 216 other source references, not including external Internet links. ISBN 978-0-9711793-1-8

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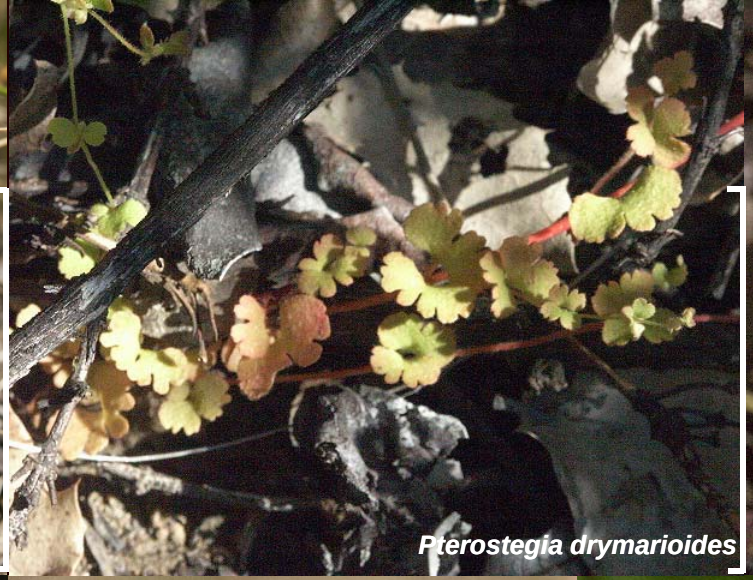
Sagina decumbens occidentalis


Pterostegia drymarioides


Cammissonia contorta

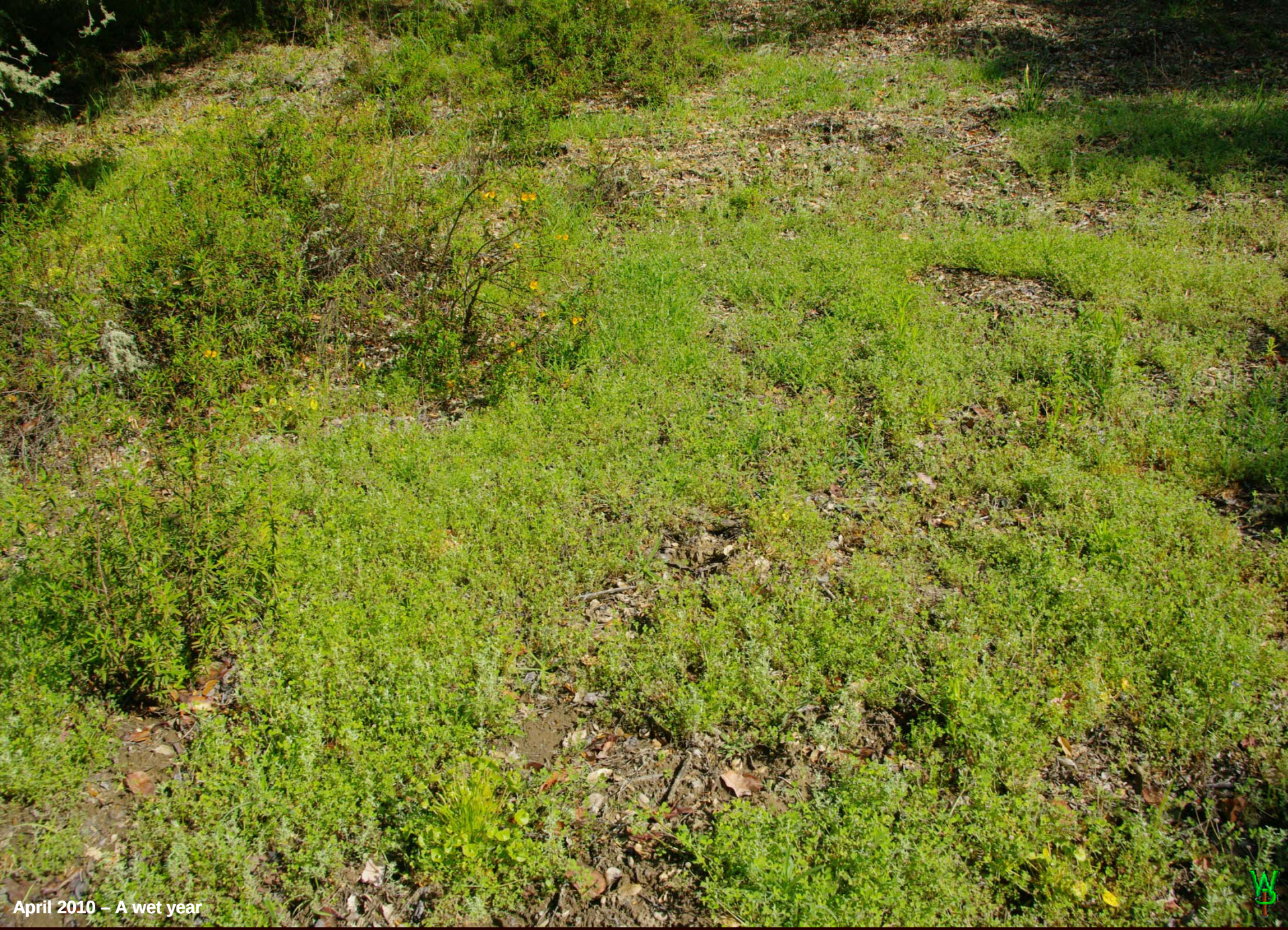

Cryptantha micromeres


Filago claifornica


Calandrinia ciliata

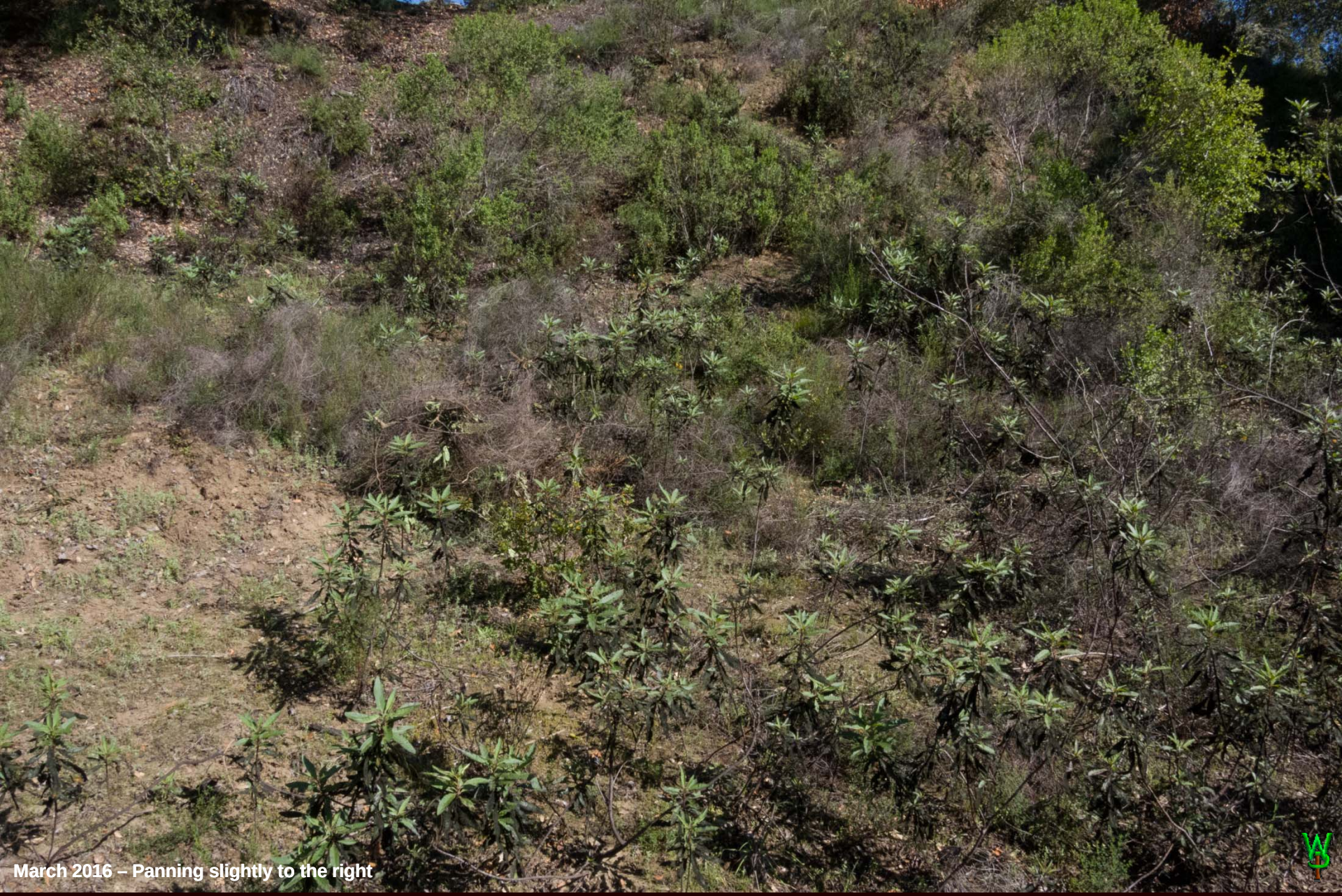

Navarretia atractyloides

This type of habitat often involves relatively small plants. The bar at the right side of each of these images is about 1”.



This was a wet spring in May, so the plants had time to grow larger for this type of system and were still lush this late in the spring.

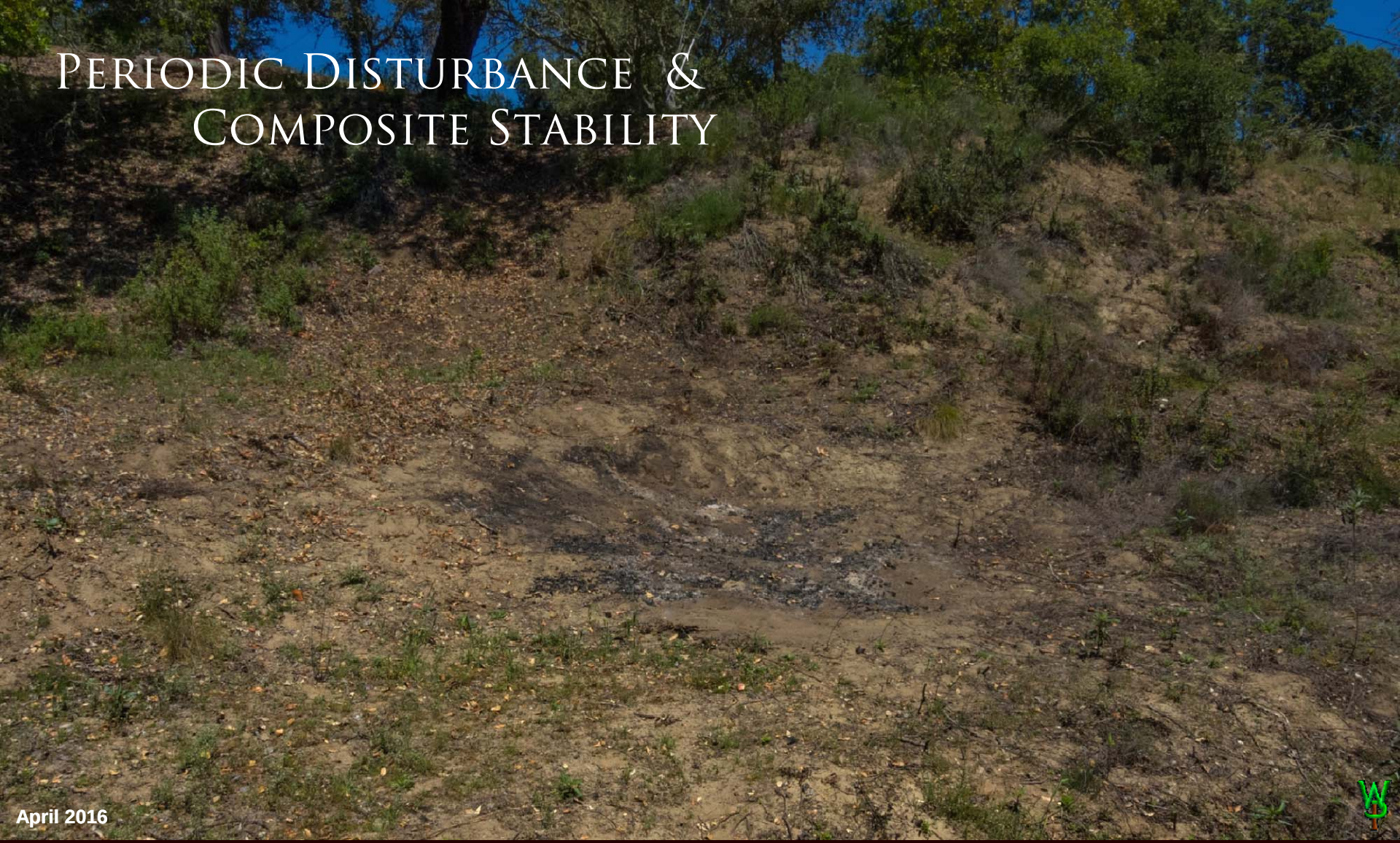
This is the same spot three weeks later. The clovers seem to have disappeared, leaving bare sand! Where did it go? I am guessing that ants took it and stored the seed. Now that the clovers are done, we're getting slender tarweed *(Madia gracilis),* and various Navarretias. Note also that the shrubs are larger than the first slide in only one year. Unless I pull shrubs and kill trees here, it will quickly succeed to brush. There are also oak seedlings here that have to be pulled, cut, or treated every couple of years.



March 2016 – Panning slightly to the right

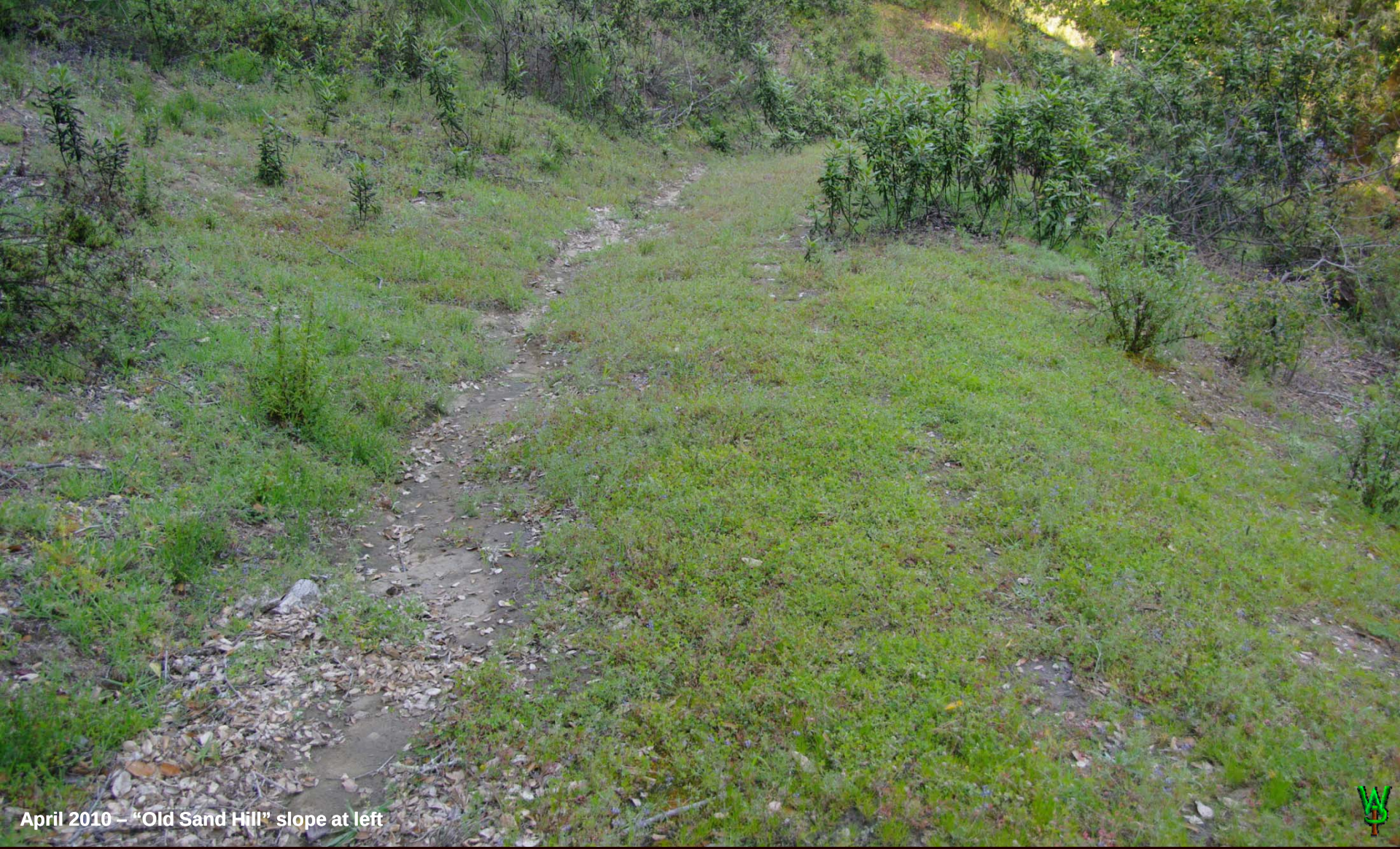
Well, I got tired of that. So, what happened? Over time, I came to conclude that the area was probably going to be too much trouble to maintain as a sand hill over the long run, partly because it is so steep that weeding it tears up the hillside a bit more than I would like and nearby oak trees were loading it up with seedlings that are very troublesome to manage. So I let it go. It took only six years (the bare spot is where I burned some tree branches a couple of years prior). I'd learned something, but frankly I didn't like the results.

Periodic Disturbance & Composite Stability



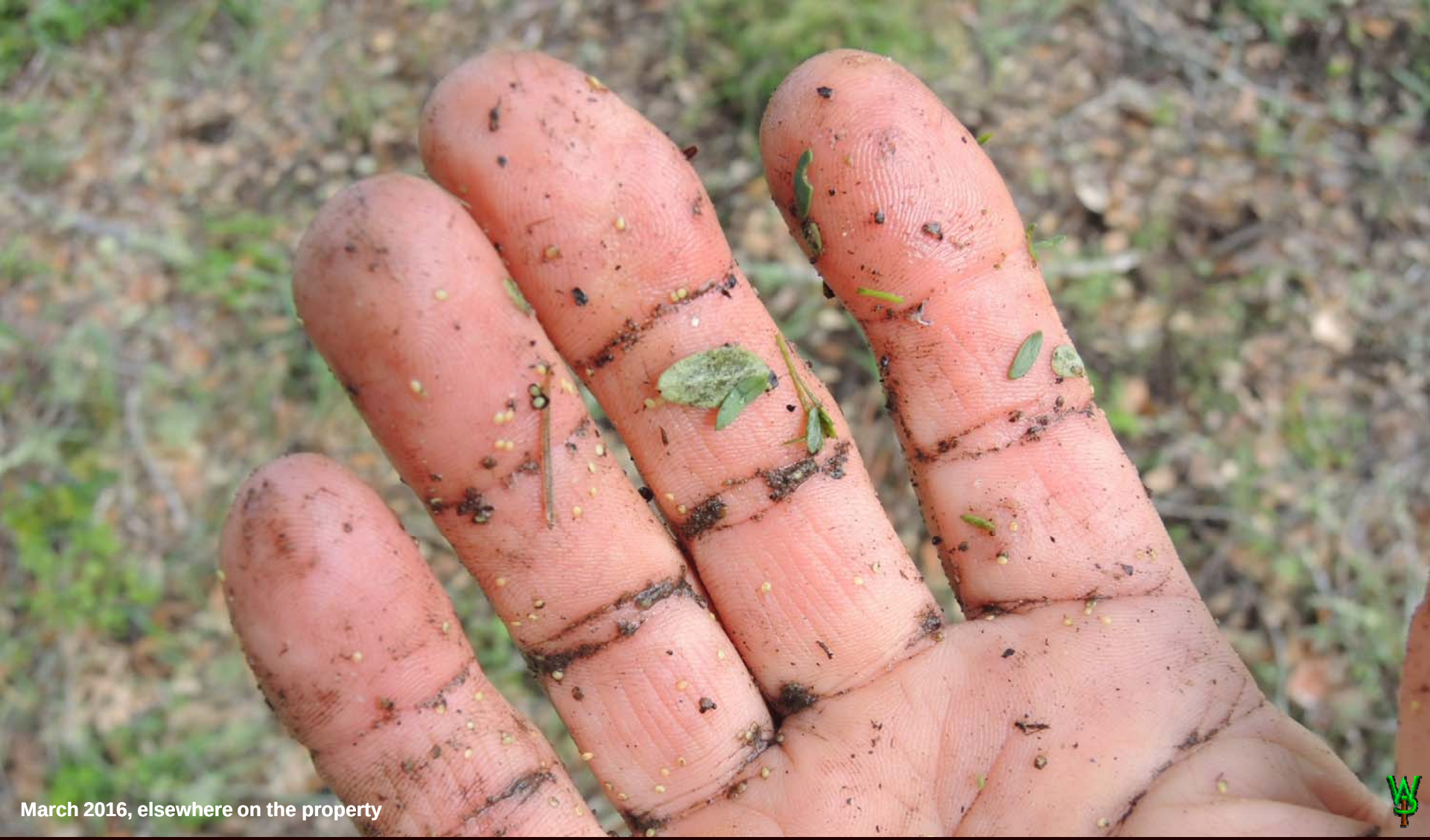
April 2016

So when the power company cut the tree that was the biggest source of the acorns, I came back to the “old sand hill,” chopped, pulled, and piled brush, and lit it off. Two weeks later, it is already showing more sand hill groundcovers: *Camissonia spp*., *Navarretia* spp*., Logfia flaginoides, Pterostegia drymarioides,* and (of course) weeds. Per the goal, I pulled some of the invading natives, particularly California brome and sprouting yerba santa. Pursuant to what happened after this burn and grading nearby, a hypothesis began to take shape concerning how post-disturbance annuals might get along in the closest thing I can fantasize as an “equilibrium” condition. One problem though**:** There is no such “equilibrium” without periodic anthropogenic disturbance; else succession takes over. In other words, optimizing Nature involves a series of what some might consider “unnatural acts.” But first a little background…



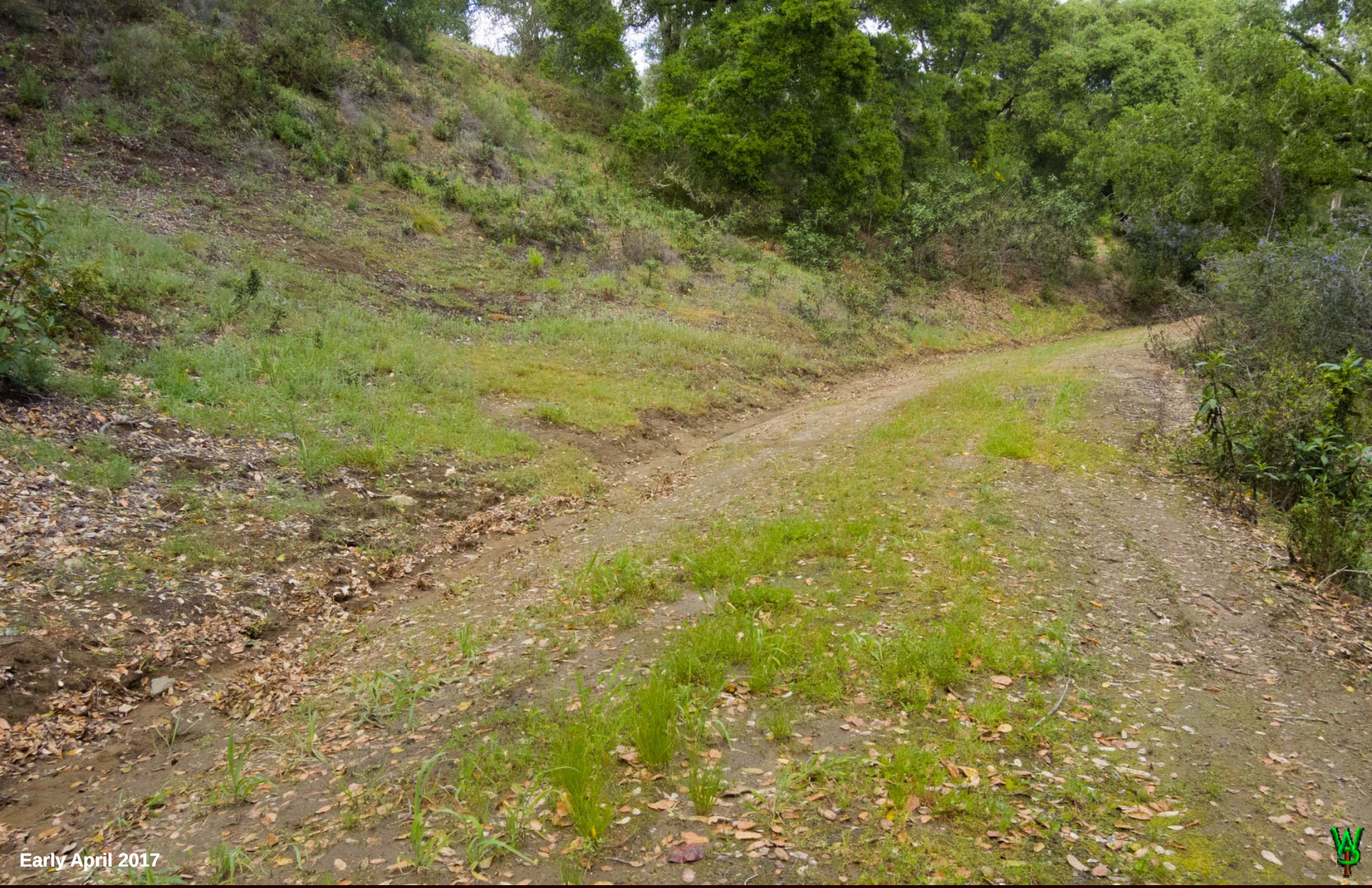
April 2010 – “Old Sand Hill” slope at left

After the five years of initial total chemical weed control, I graded this road in 2006. I weeded and spot sprayed the heck out of it at least five times every year thereafter. At first, it was relatively easy, because there wasn’t much native that came up besides clovers. In subsequent years, clovers remained dominant, despite the fact that there were a great many other things popping up until it all became incredibly complex. Germination in 2010 (above) was spectacular. One might think therefore this clover dominance was some sort of successional hierarchy with clover being the “pioneer species.” Looking back, it seems more likely that things turned out the way they did because the year following the grading just so happened to have extended warm spring rains too, making it a good year for clover, thus giving that genus a head start in total seed deposition. It was a series of subsequent events that led to the hypothesis to come.

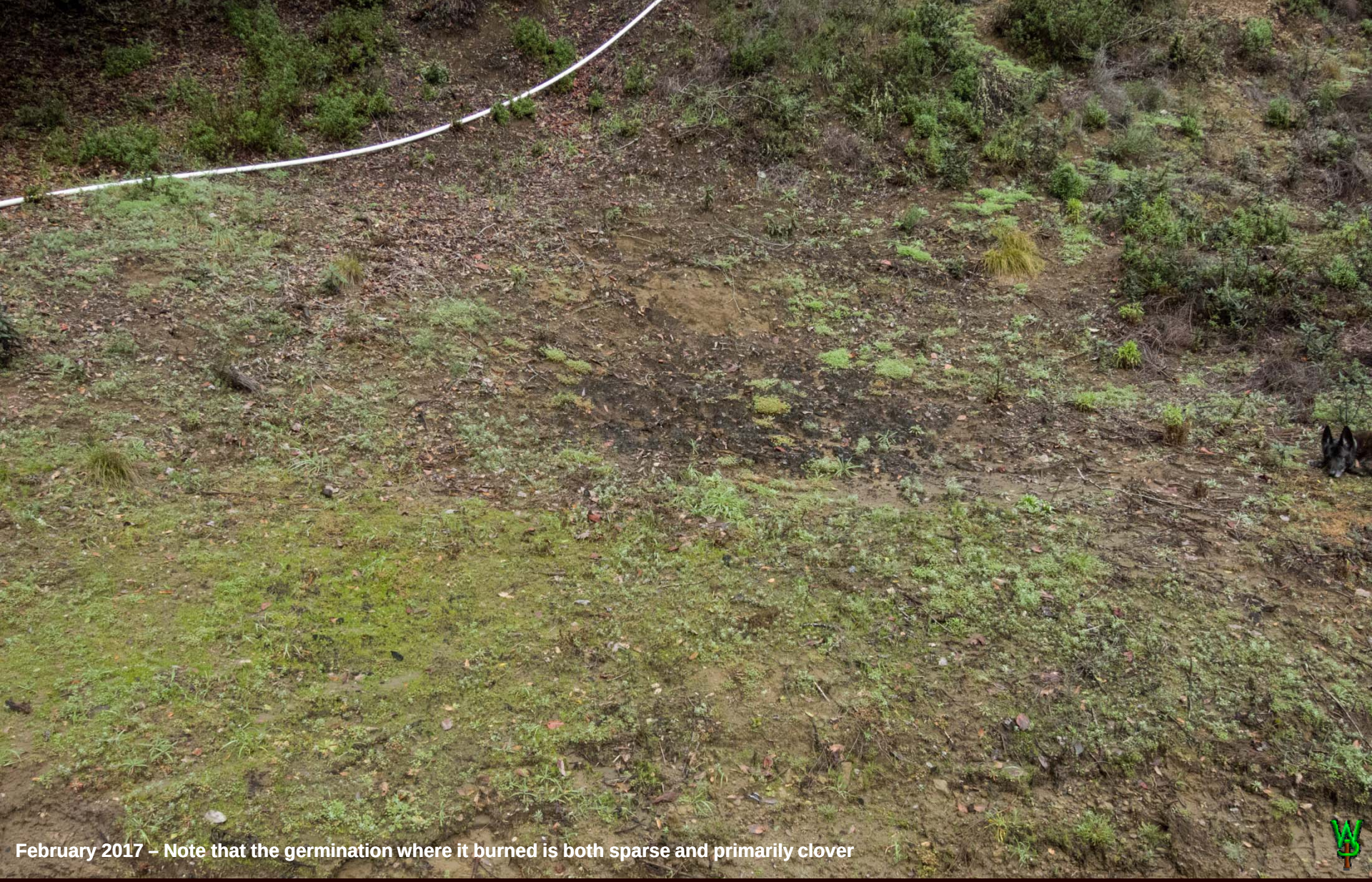


March 2016, elsewhere on the property

The first event was the realization of a pending catastrophe. As mentioned in the Introduction, in what should be a case of punishable negligence, the botanists at the University of California and the California Department of Agriculture had blown the identification of exotic *Cardamine hirsuta* (bitter cress), a persistent weed ubiquitous in the nursery business. They believed it to be native *C. oligosperma*. Bitter cress has clearly been established Statewide for at least 50 years, a pest about which they quite apparently didn't care. By spring 2014, when Randy Morgan and I confirmed the mistake, this road had a fair bit of it. It came up like crazy in fall 2014. This is a weed that can breed so tiny and so fast that it is impossible to control manually. Under circumstances like these, I get to save what I can, and/or kill everything; else I lose the whole project. In 2016 I planned to grade the road and could not afford to spread it. So in the rainy season of 2015-16 I nuked it twice with a combination of glyphosate (Roundup) and pre-emergence oryzalin. This was war.



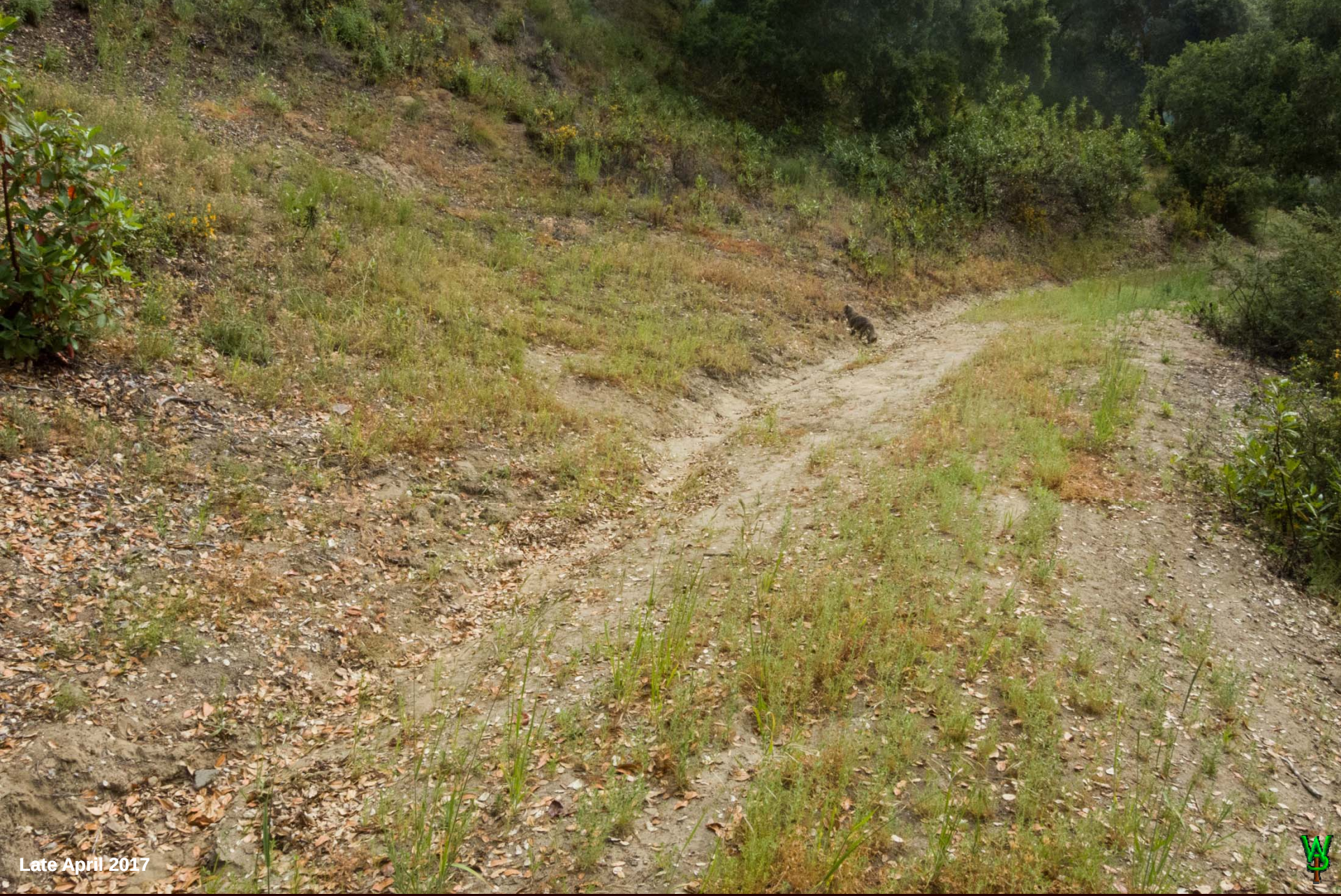
That fall of 2016, I graded the road, leaving a stockpile on the right later removed that fall to grade a nearby trail (15 yards, one wheel-barrow at a time). Needless to say, I was NOT going to take the usual government-prescribed “erosion control” measures, seeding with grasses and mulching with straw! Then in early 2017 we got an immense drop of some 87 inches of rain, over 50 of which were in two months, which forced the seed bank into action across the entire property. What came up on the road was California brome grass from and *Navarretia atractyloides*. The pre-emergence herbicide had little effect on the bitter cress seed bank, but there wasn’t much clover.



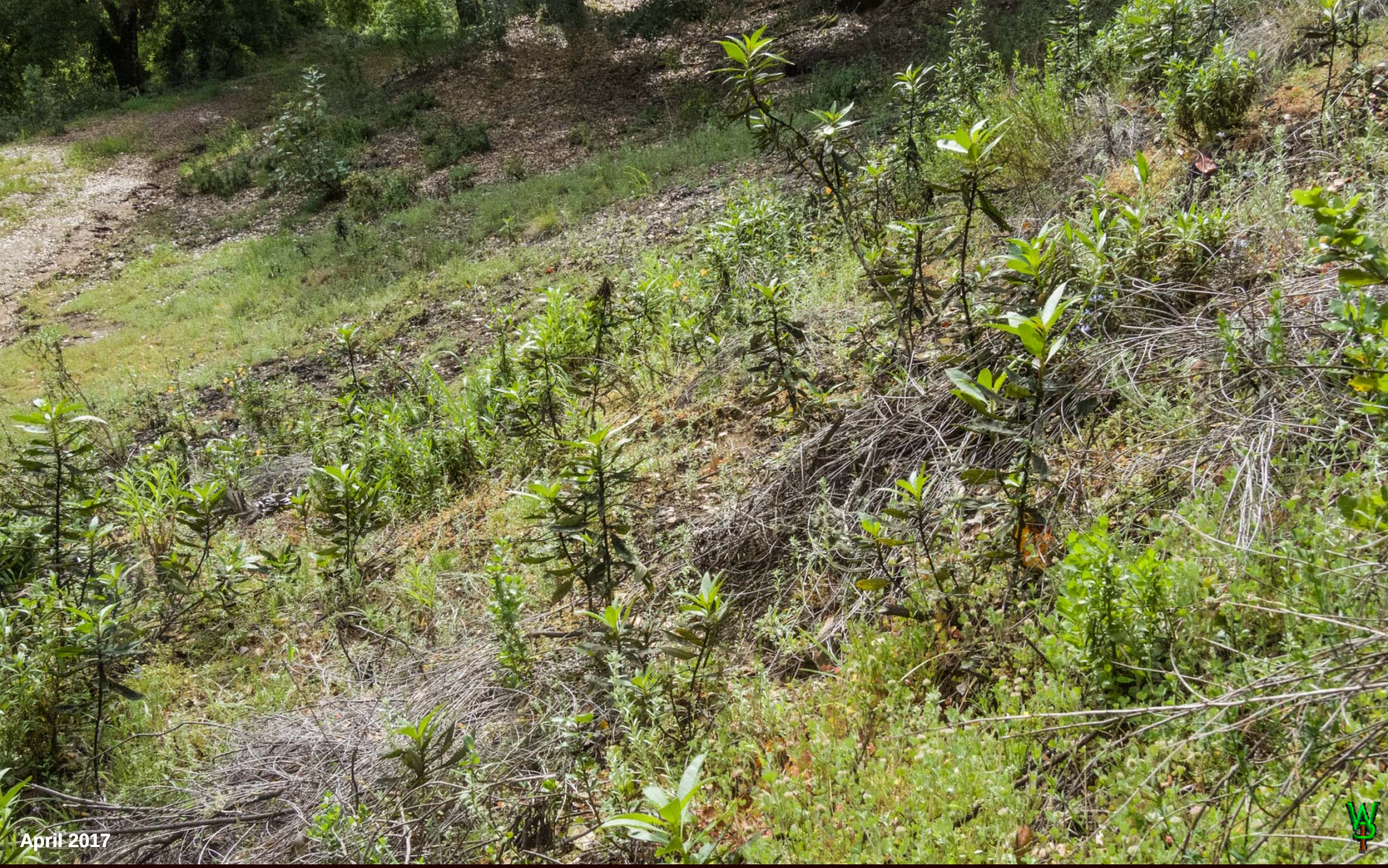
February 2017 – Note that the germination where it burned is both sparse and primarily clover

The result up the hill the next year was more predictable, but given the heavy rains in 2017, it was intense. Of particular interest was the spread of a relative newcomer here, fairy mist *(Pterostegia drymarioides),* which may yet become widespread. The problem with fairy mist is that its early leaflets look very much like our nemesis, *Cardamine hirsuta*! It also makes a mat, so that late germinating bitter cress is virtually undetectable until it puts up a stem. That means I get ONE WEEK to find them all while trying to weed the rest of the property. That means I have to be here every two to three days to obtain acceptable yields or I lose here too.

Closer up on our “old sand hill” it was OK for **clover**, but a great year for California **cotton-rose** *(Logfia filaginoides)*, ***Camissoniopsis*** spp., and *Pterostegia drymarioides* (“**fairy mist**” the orange stuff). All of these post-disturbance native annuals can be pretty invasive but at this point they were still just getting going again in this area after I had burned it in . Yet you will note there is not a lot of *Navarretia*. So, which one will be dominant on the road below after the next disturbance? Is this hierarchy, cascaded opportunism, or both?

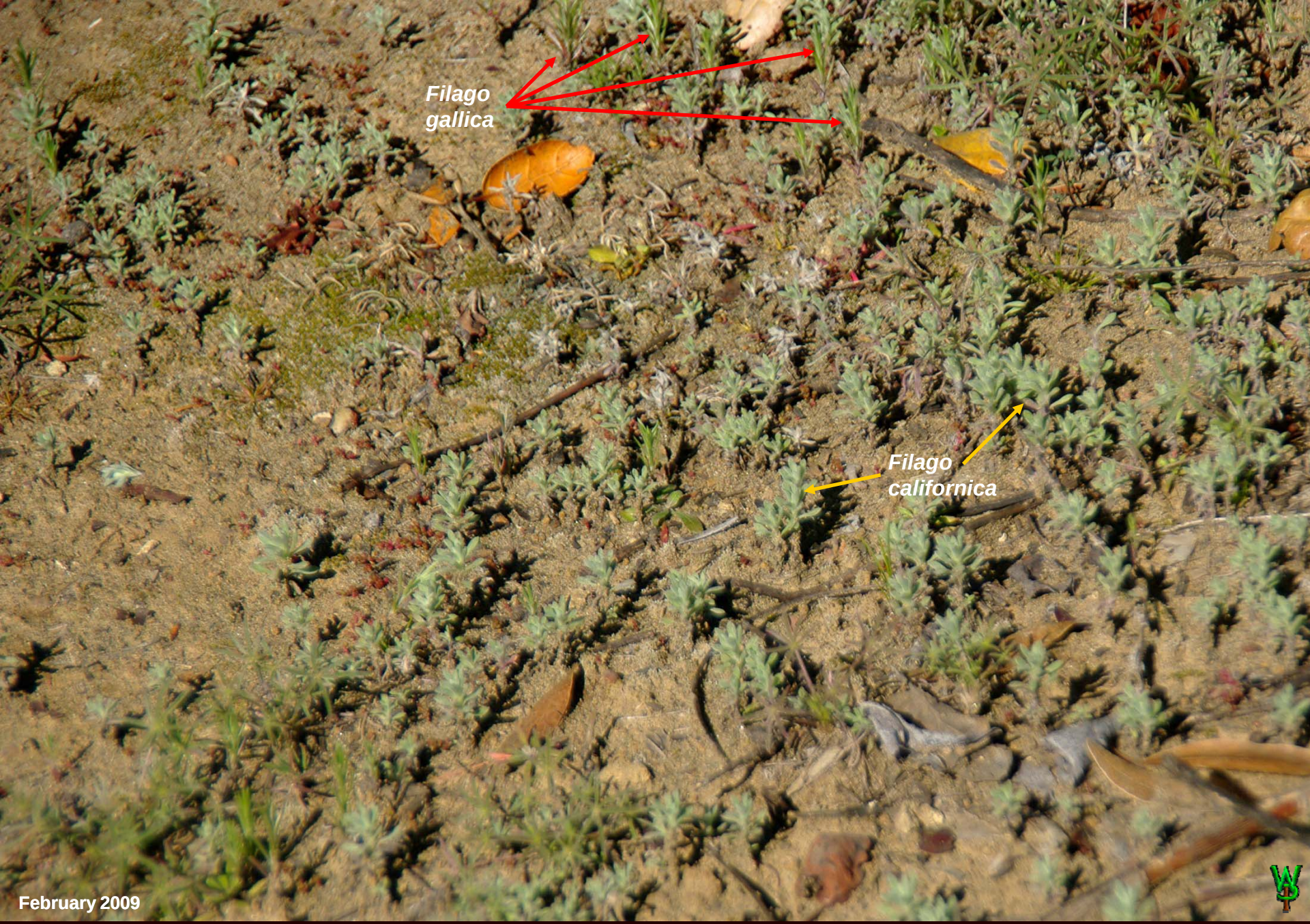


Previous pre-emergence treatments elsewhere had suggested that weak deposition rates are very effective at clearing fast-germinating seed like *Cardamine* while leaving a larger fraction of native seeds that tend to germinate after the herbicide has worn off. Had I killed the clover seed on the road? Possibly, but I don't think so. There had not been much skunk weed up above. Unlike 2010, this had been a uniformly cool winter, with mediocre clover germination generally but a great crop of skunk weed elsewhere on the property.

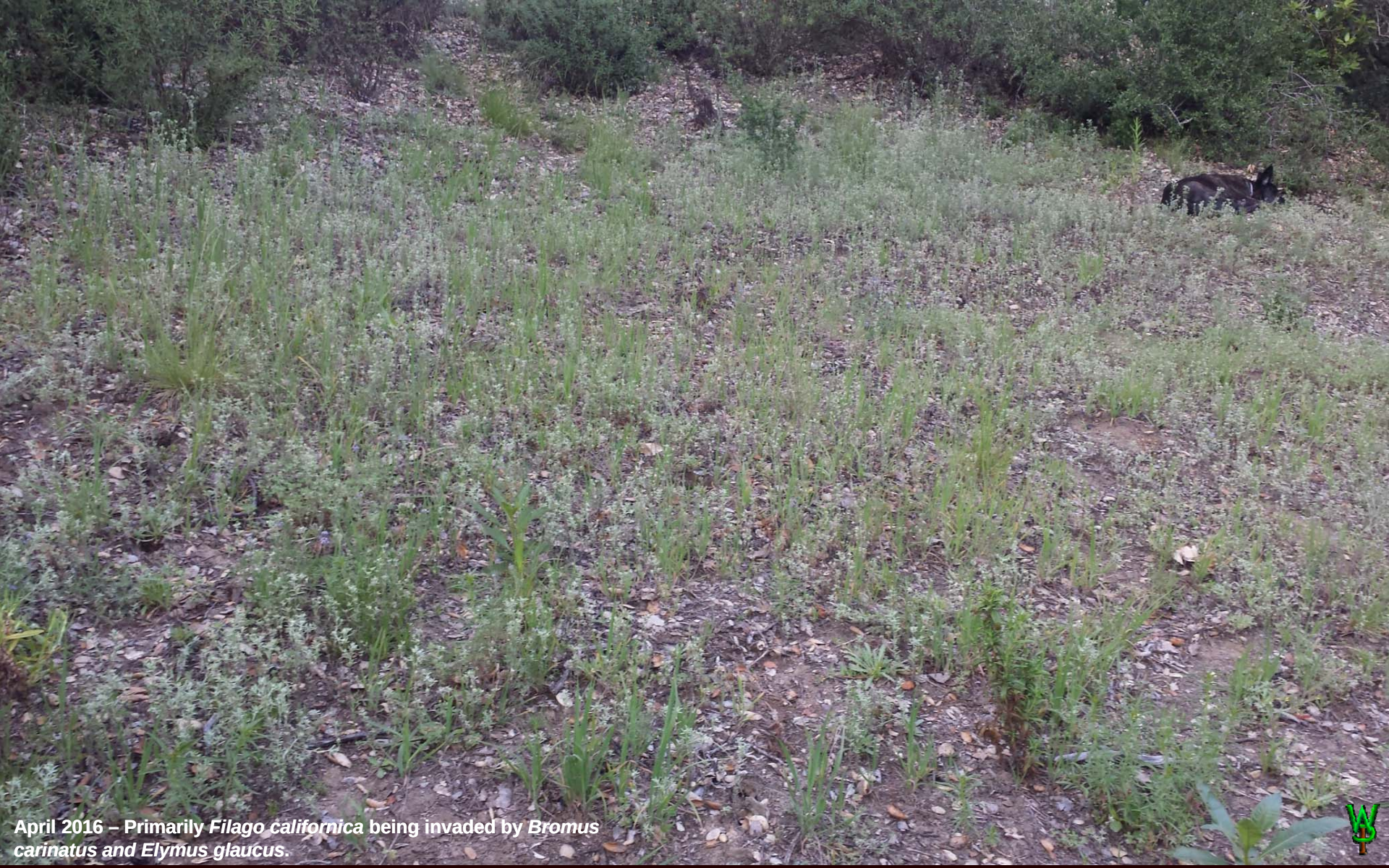


Note that clover is dominant in the foreground on this ridge above the road where there is more sun than below. My point in offering this sequence is that with each disturbance one gets the best production the next year out of what tends to come up given those particular climatic conditions. Obviously, with a diverse native system that means more variation from year to year. Each time one disturbs it, there is a higher probability of abetting something different, simply because of variations in weather conditions. Over time, this means not only maintaining early successional conditions, it builds more variety in the seed bank. Using prospective knowledge to manage by periodic disturbance, more species are showing up here every year but at a decreasing rate, eventually forming what I call composite stability.

Having once given up on the old sand hill site, I wanted to have a sand hill community some place, so, I thought I would see if I could *make* one where it would be less trouble. On this spot about 70' away I pulled all the shrubs, put them in a pile, added tree branches, and lit it on fire for about five years in a row. Voila! It started out as *Lupinus bicolor, Filago californica,* and of course weeds.



It now comes up with *Logfia gallica* and *L. flaginoides* (was *Filago californica*) which forces me to remove the exotic, one by one. The exotic used to outnumber the native 50:1.



April 2016 – Primarily *Filago californica* being invaded by *Bromus carinatus and Elymus glaucus*.

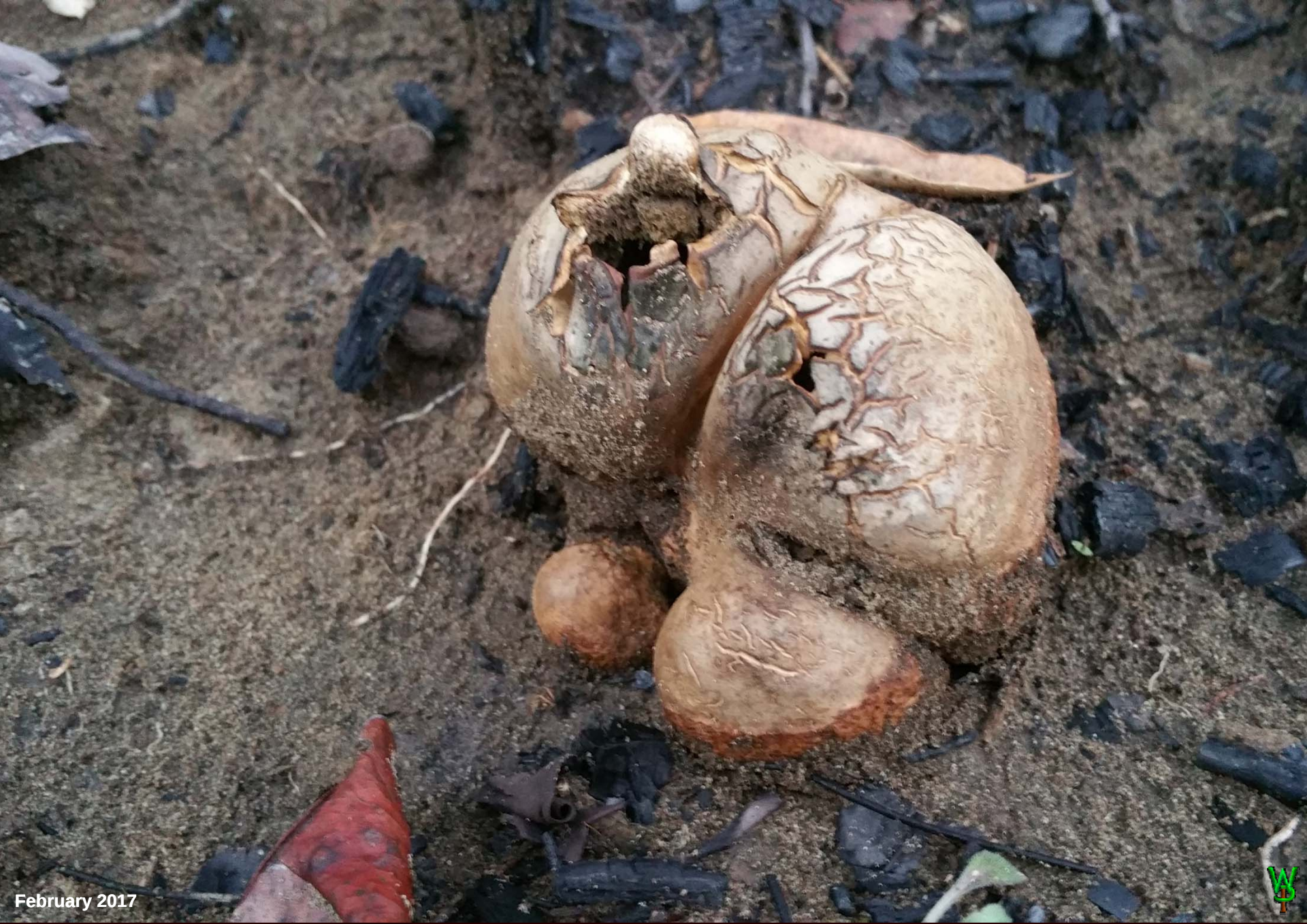
It is not hard to see how much more dense our “new” sand hill species have become. This patch of California filago is now three times the size of what one local botanist called the largest he had ever seen. It has also hosted two rare mushrooms. But if grasses invade it and seed, I get to start over. Once brush seed is deposited then if I burn it, the brush will come up *with* the sand hill species *and* the grasses until the sand hill species are crowded out, essentially a “recovery” of everything at once. The longer succession progresses before a disturbance, all levels of succession (up to the highest present at the time of the disturbance) respond simultaneously if they can, thus increasing the rate of succession in the system as a whole, simply because one does not have to wait for the seed to invade.

Did I say sand hills get complicated? I counted 15 natives characteristic of sand hills in this photo (about 10-12 square feet), with another 5 immediately nearby. All told, there are at least 45 plant species within 20 feet of this spot.

Cammissonia (spp.), are a known Indian staple for both roots and vegetable matter. They are common among rocks and sand here, but most are too small for food (although they grow big in road base-rock). They do better in rainy years. As a vegetable food, they are bitter and the texture abrasive.

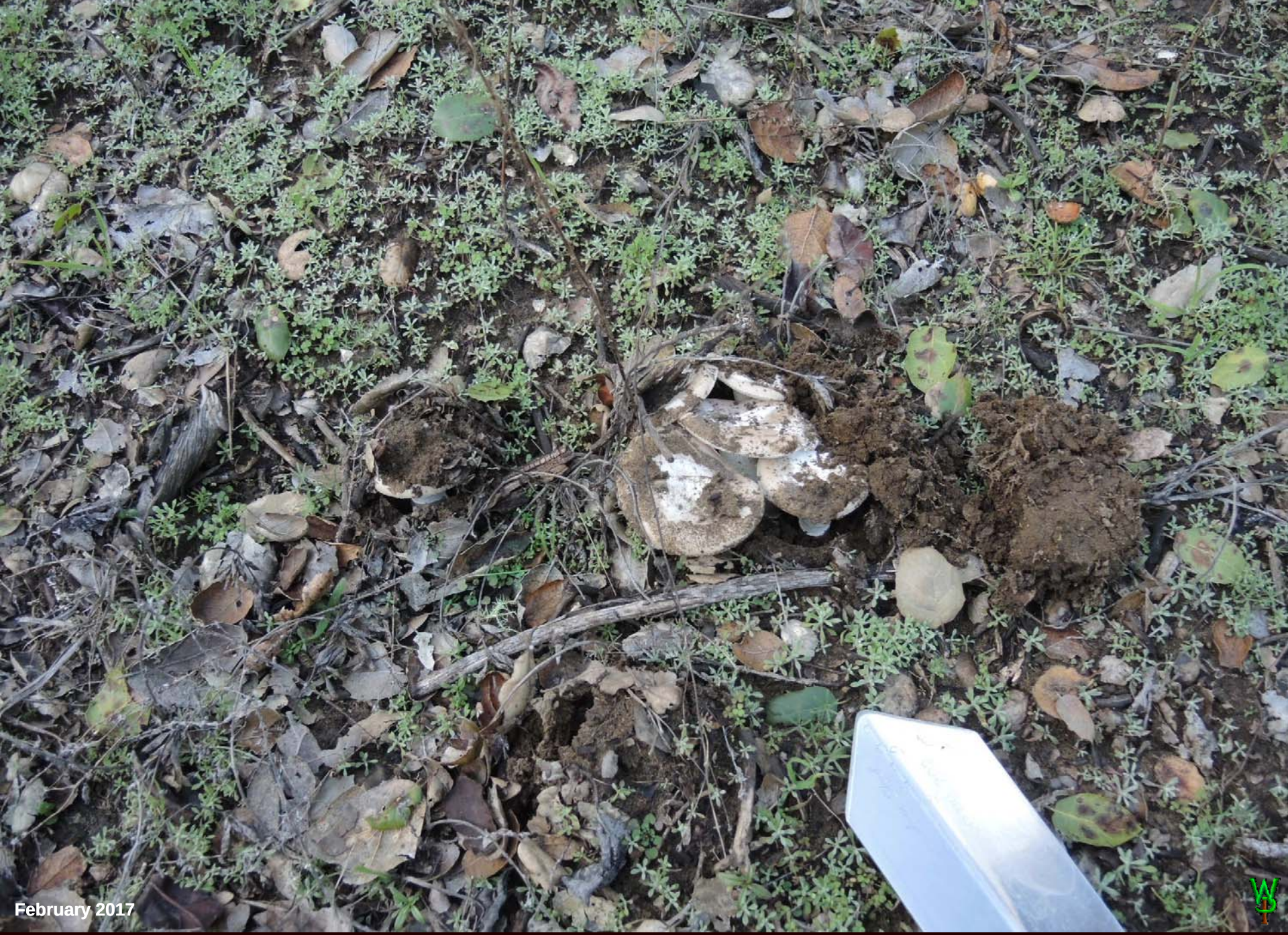
As you can see, many of these plants have a reddish tint to an unusual degree. I suspect this is because we have had nearly 70 inches of rain so far and we're only half-way through February at this writing. I would expect any available nitrate to have been completely rinsed from this sand.

Note that at the edges of this sand hill near the oak trees to the left, the forbs are greener and much larger. Given the historic availability of water in 2017, one wonders therefore if they might be getting nitrates from the leaf litter under this nearby oak. Oak tree litter contains tannins known to be broken down by actinomycetes. Study of the nodules on the roots of these clovers suggests that they are NOT making nitrogenase on their own, I suspect due to the lack of molybdenum.

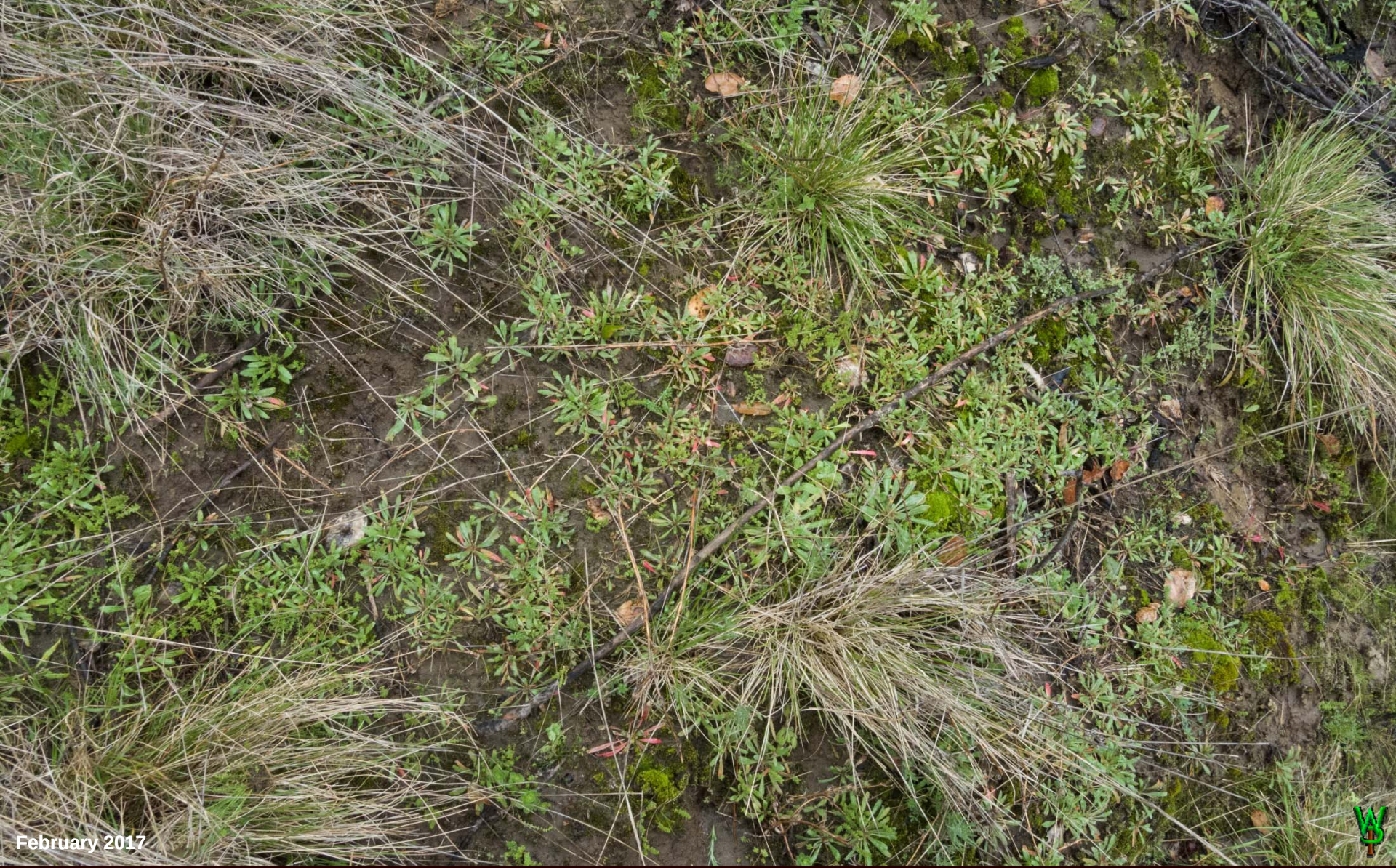


February 2017

This *Scleroderma geaster* was found near the greener clovers at the edge of our “old sand hill,” suggesting that it might transport that nitrate. Such relationships using trees as a source of tannins might be one of the advantages of a savannah configuration.

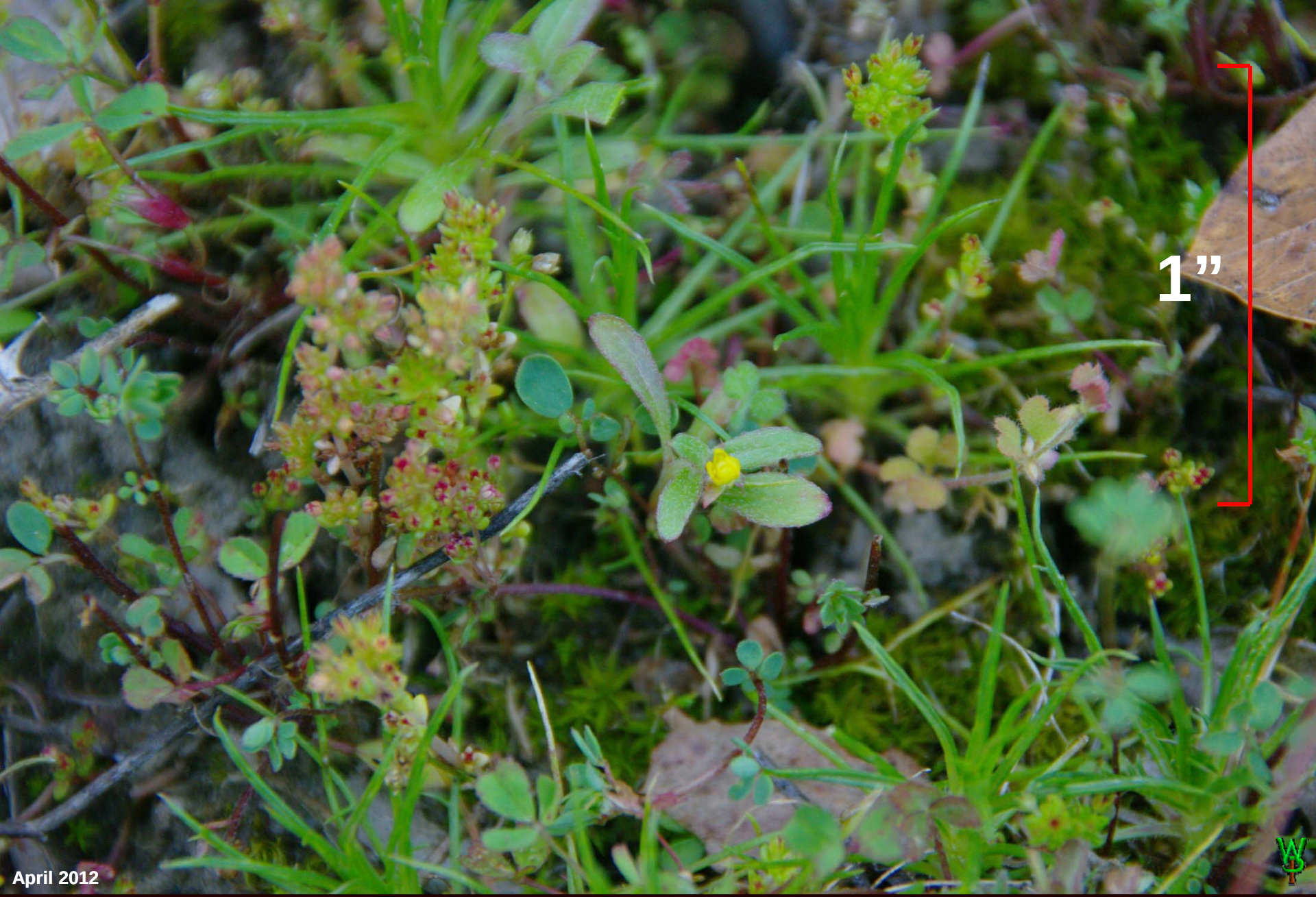


We also know that *Amanita calyptraoides* is mycorrhizal to oak and inhabits this “new” sand hill almost 40 feet from the nearest tree.



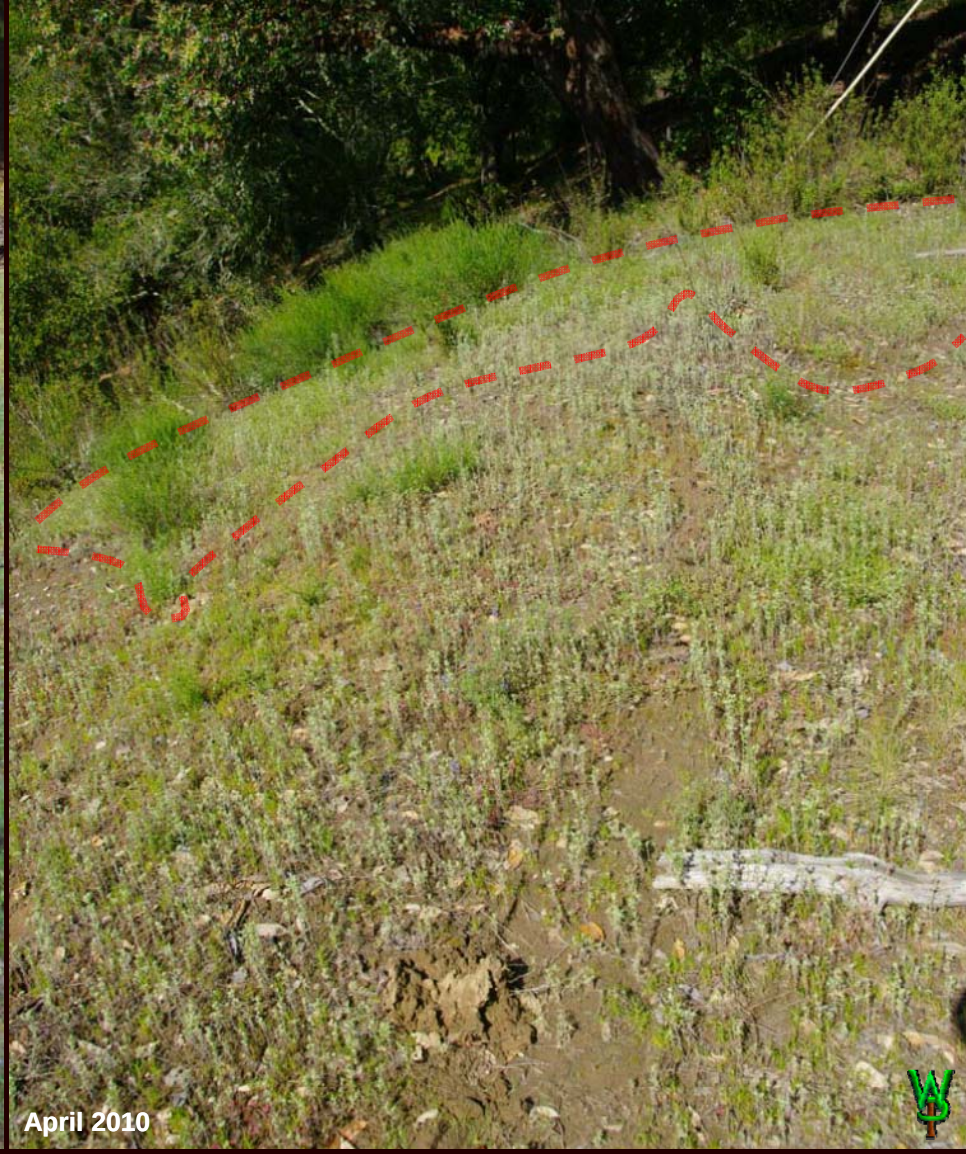
In Camissonia particularly we are seeing some native sand hill species invading grasslands. Examples are *Navarretia atractyloides*, *Filago californica*, and *Calendrinia ciliata*. I suspect this is seldom observed but may have been usual in this area. It is one thing to get rid of non-natives; it is quite another to do it on a scale that allows the native annuals to mix in numerous and different conditions, such that one can observe what their relationships might be at the fringes of their usual habitat (including microbial and insect cohorts). One must often wait for years for repeated weather-related events to produce sufficient seed for it to spread larger distances in quantity.
Hence: This process of colonizing and reestablishing native post disturbance cohorts across a landscape can take many years.

But one just can't appreciate "small" or how complex sand hills get until you see these plants together. To weed this area effectively and efficiently, lighting is critical. Side lighting illuminates the erect weeds, such as grasses, wall bedstraw, and *Filago gallica*. Vertical lighting is more important to detect weeds covered in the groundcover understory (cat's ear). Yet the average height of this cover isn't more than two inches tall. So I hope you are wondering what I mean by "understory" when talking about low growing groundcovers.

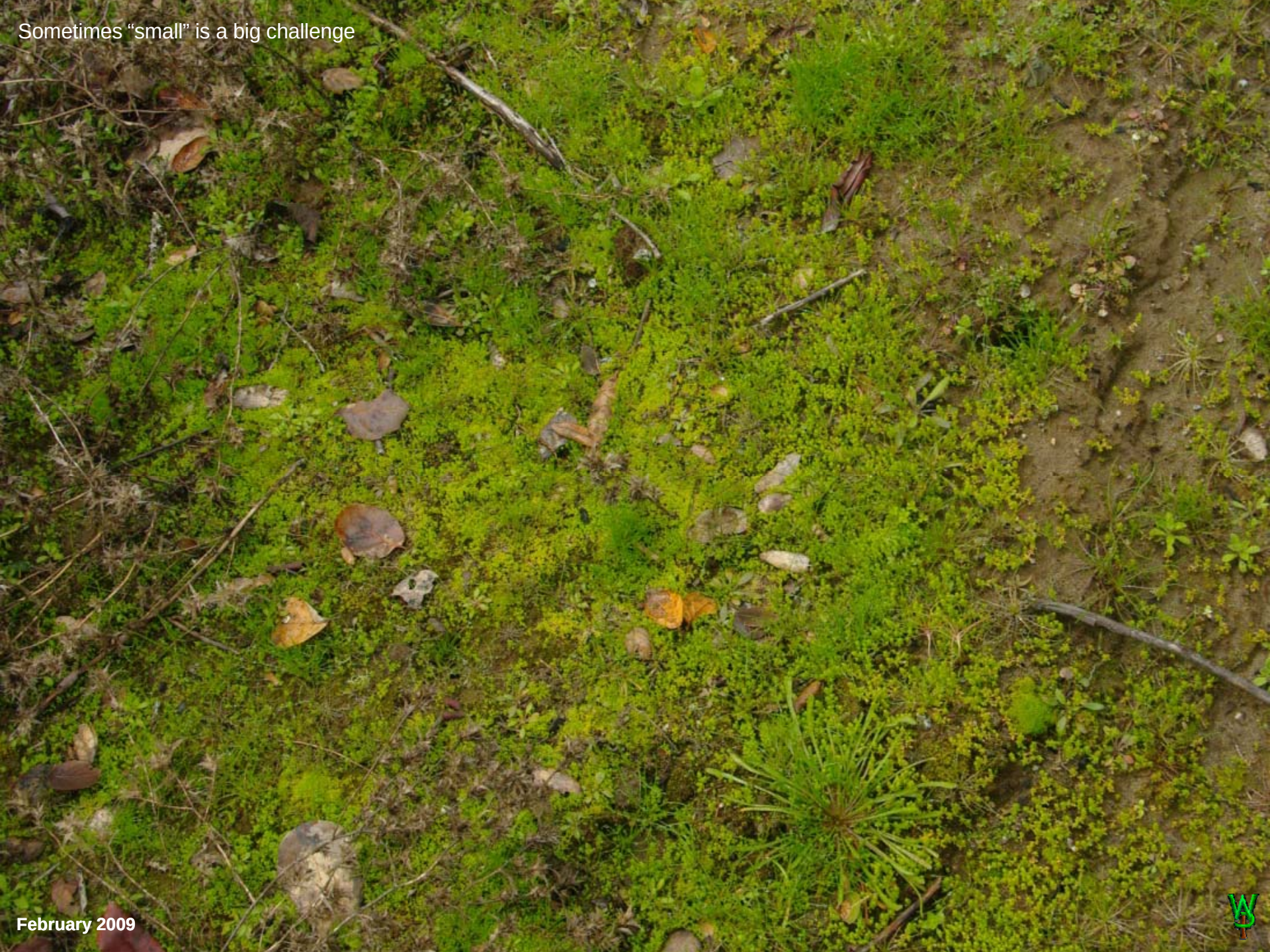


Well, here it is: Stonecrop *(Crassula connata)*, *Acmispon parviflorus, Trifolium gracilentum* and *T. microdon, a Cammissonia, Navarretia*, and mosses. We do “small” here. Four leaved allseed (*Polycarphon tetraphyllum,* a weed found here but not in this photo) grows as small as the mosses in this sand as do wall bedstraw seedlings, with a tap root to boot.

That prior image came from the red spot in the background toward which the arrow on the next slide is directed.
Variety and detail that intense are weeded on a scale like this.



This is the ridgeline 75' above the base of the sand hill. On the left is April 2009 and on the right is the same spot the next year. Although the bumper crop of lupine in the left slide bred successfully, their seedlings did not appear the next year. 2010 was not a good year for lupine in general, which seems to prefer a drier spring, but that is probably not the reason you see so little of it (of which there may be several we will discuss). 2010 was however a GREAT year for clover. Yet you don't see the clover up here, except in a few denser patches near the back (red outline). This distribution, plus the fact that I stirred up this patch with a hoe five years prior, is strong indication that the clover seed bank on this ridge was once totally exhausted. The dense clover patches in the red-outlined area are the scions of the colonizers up on top from recent years. That colonization process will be discussed in a later chapter.


Sometimes “small” is a big challenge
February 2009


Do it for too long at any one time and you start seeing things.
March 2012


It can take quite some time when you’re doing it by hand.
March 2010

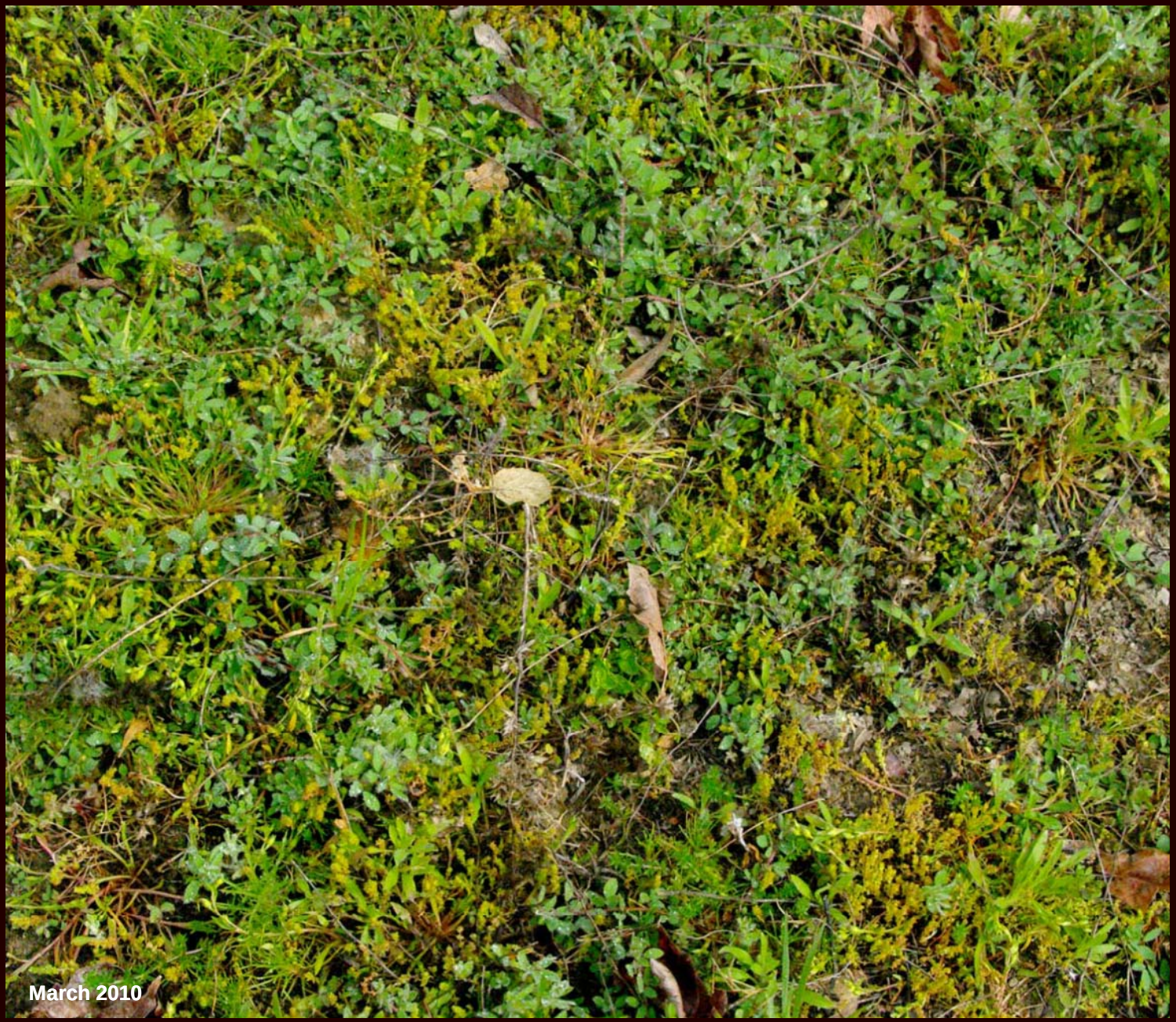
February 2015

A sand hill can be profoundly complicated…

One that is usually Filago in most years, in others might come up with lupine…

A rocky wall can bring up all kinds of things…

Because these guys don't care what they grow. Native or exotic, it's all good. In sand hills, they play a major role in what comes up from year to year. Yet there are other factors involved, in that with a recovering native seed bank, not all of the plants are yet well distributed.

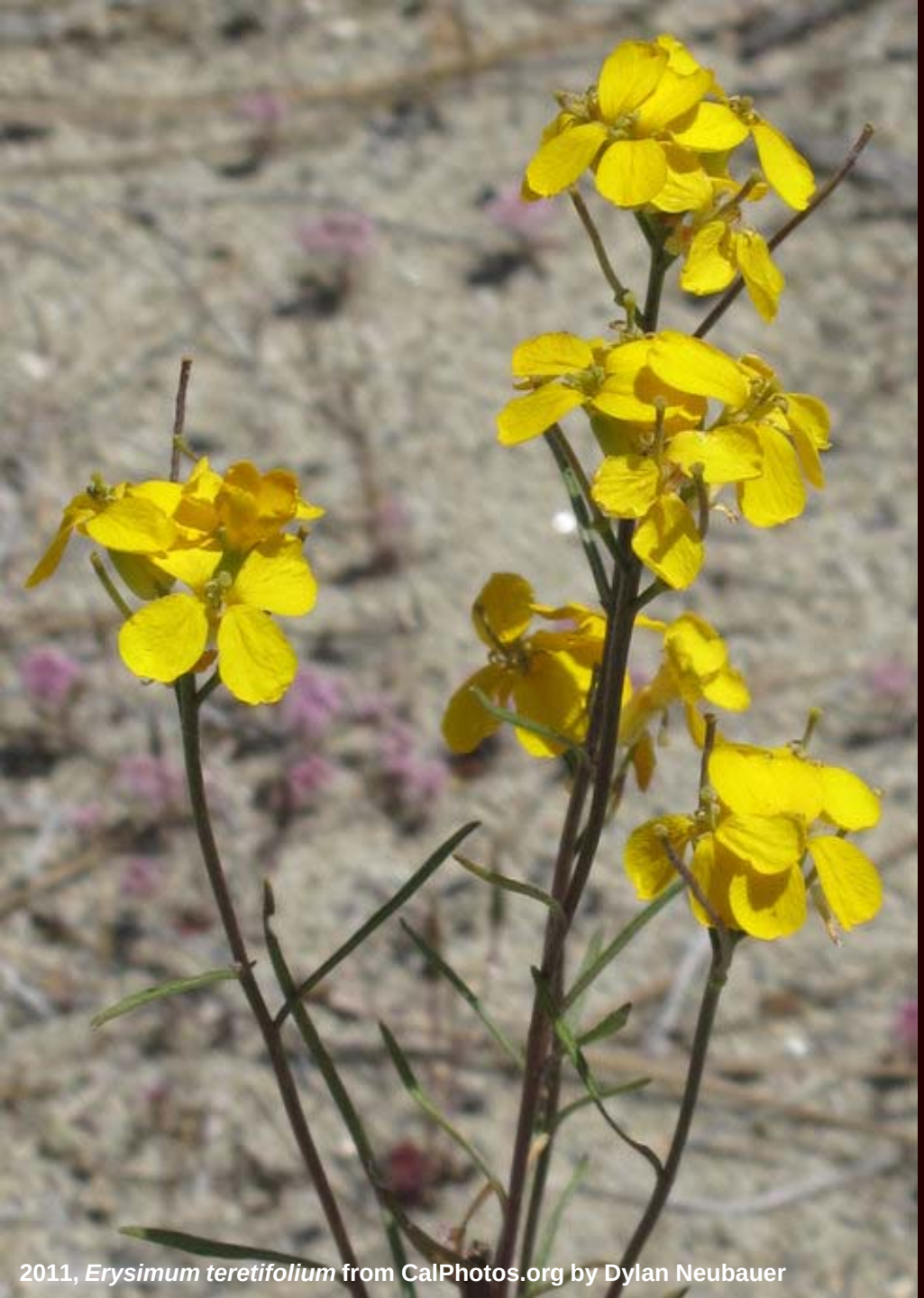


All this variety has its consequences when one is making decisions about what to keep and what to weed. This area is entirely native forbs**:** red maids *(Calendrinia sp.)*, stonecrop *(Crassula connata)*, skunkweeds (2), and 3 lotuses (insets). It is a considerable difference from what was here before…

The red maids can be spectacular. At this time they were just getting established. If we get some rain, this will be amazing.

Then there are the *Navarretias*, in particular *N atractyloides*, aka “skunk weed.” I wish to impart a word on *Navarretias*, as it has become “hip” to express one’s love for such an unlovely plant. It has its’ uses (as I will mention in the chapter on bees), but I have no idea why anybody would “love“ it, unless it was to posture as being such a “Nature Lover,” so attuned, so special, so smart… as to love the unlovable. It stinks when bruised. It is very unpleasant weeding in them. The spines hurt. They break off in your skin. They’re barbed. About the only sane time to weed in it is after a soaking series of rains. I have no doubt why an Indian would light it on fire.

There are several inarguably sand hill species once found in this area that are now extinct here, in particular Scotts Valley Spine-flower *(Chorizanthe robusta var. hartwegii)* and Ben Lomond Wallflower *(Erysimum teretifolium)*. I would be willing to host them up here, but only if their “protectors” would please leave me alone. Of course, that would make the plants less endangered and there would be less need for the protection (probably can’t have that). G_d forbid that we should GROW them in more places to reduce the total risk.



2011, *Erysimum teretifolium* from CalPhotos.org by Dylan Neubauer

The should-be-obvious-by-now point about sand hills is that frequent disturbance is what sustains the variety, complexity, and seasonal variability we see in sand hills. The key for these annual plants is specifically programmatic disturbance by people. Without lighting it on fire every year or two this system is quickly overgrown (as will become more evident in the concluding chapter on succession).

Unfortunately, nearly every post-disturbance weed loves to germinate in sand. That makes maintaining a sand hill technically-demanding and potentially hazardous to these plants in places frequented by the public. Yet the only places allowed to grow them are parks, open space preserves, conservancies, and land trusts frequented by the public!

Can we trust the professionals to keep these plants safe? Please hold that thought until you are done with the rest of the book. When one truly confronts the record of public agencies and land trusts and the political constraints they face, it is not encouraging. Yet even if the public did supply all the "funding" these land management service personnel are demanding and took every draconian measure their bureaucratic sponsors expect (that together have been shown to be cumulatively catastrophic to the economy), what if the simply curious enthusiast (or even a random animal) introduces a catastrophic weed or soil pathogen (such as *Phytophthora tentaculata*) into that preserve. This pathogen requires total fumigation of the plants' habitat to stop it. Is it not more likely that these species will survive if they are also maintained in an array of isolated private refugia with which to repopulate these public reserves?

Both wall flower and spine flower were once found close to or on our property, as documented in 1938. That makes the Wildergarten a suitable habitat. Then why are those "protectors" making reintroducing these plants so difficult and hazardous to my property rights when they should have every reason to *want* me to grow them here?

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