Teaching Tolerance

Ok, you've heard plenty about how Wildergarten is all native, but one has legitimate reason to ask, 'What difference does it make?' This is much better than is typical of wild grasses one sees in the Bay Area in mid-spring, because this is very fertile level Silicon Valley bottom land with partial shade. The rains had been good the prior two months. This is a combination of non-native rip gut and slender oat. These annual grasses are done for the year. What green you do see here are non-native broadleaf weeds.

Wildergarten 4.1

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

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

Articles at Wildergarten Press**:** collected writings on Constitutional history and regulatory racketeering by tax-exempt “charitable” foundations

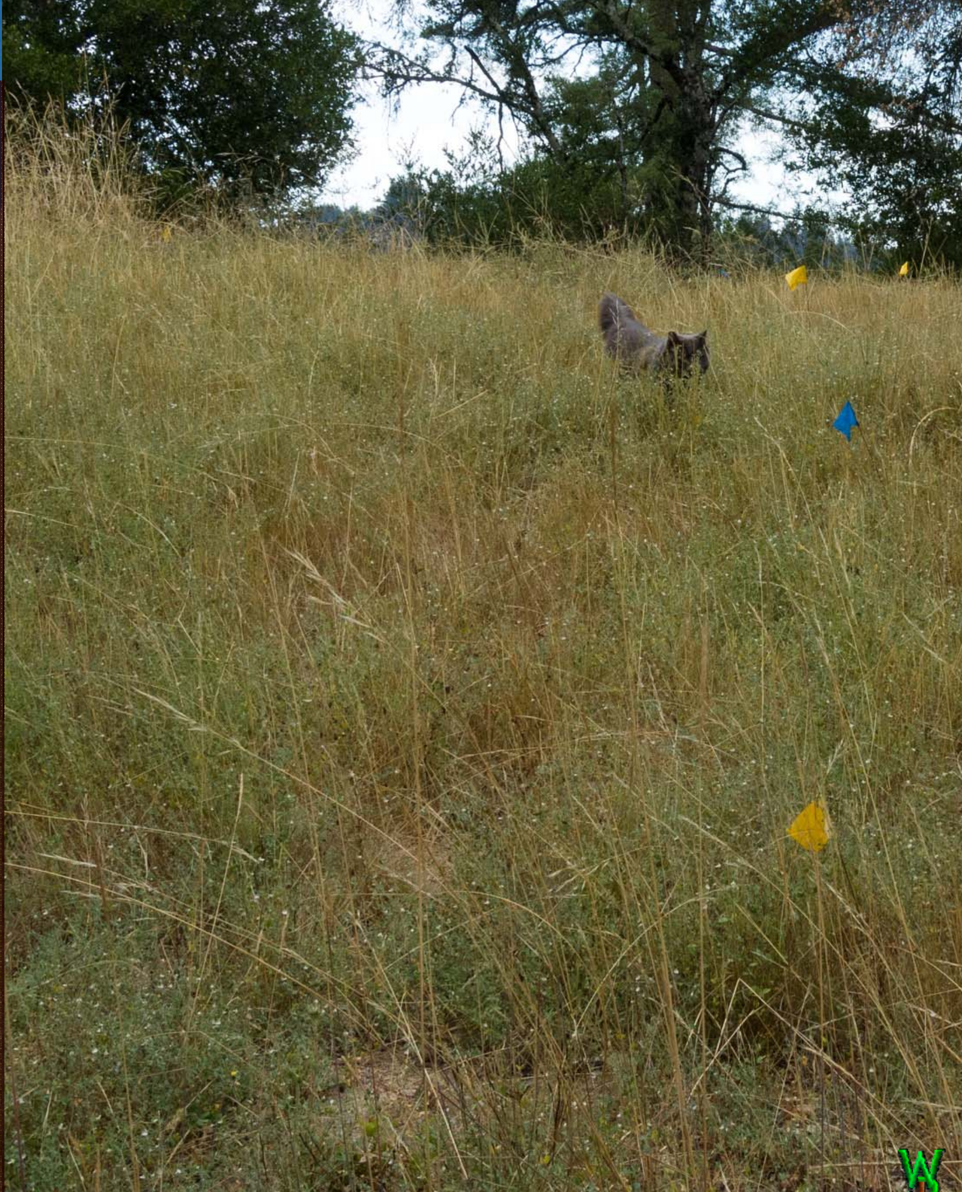
Wildergarten Press
P.O. Box 98
Redwood Estates, CA 95044-0098
www.wildergarten.com

This is one of our grasslands of California brome and blue wild rye the same week. This slope is almost pure sand. The right foreground was bedrock sandstone only ten years prior. These grasses are almost twice the height of the bromes you saw. It is much hotter here than in Silicon Valley, which is in a marine climate adjoining San Francisco Bay. But this difference is not the big deal.

This is California brome *(Bromus carinatus)* in August, growing in a very poor sandy soil in full sun. You would never see this in a sunny spot like this in the Bay Area in August. No way. I promise you: It has not been watered since just after it was first seeded in 2004. Obviously these are perennial grasses, so one might be led to expect that such makes all the difference. There is more to it than that.

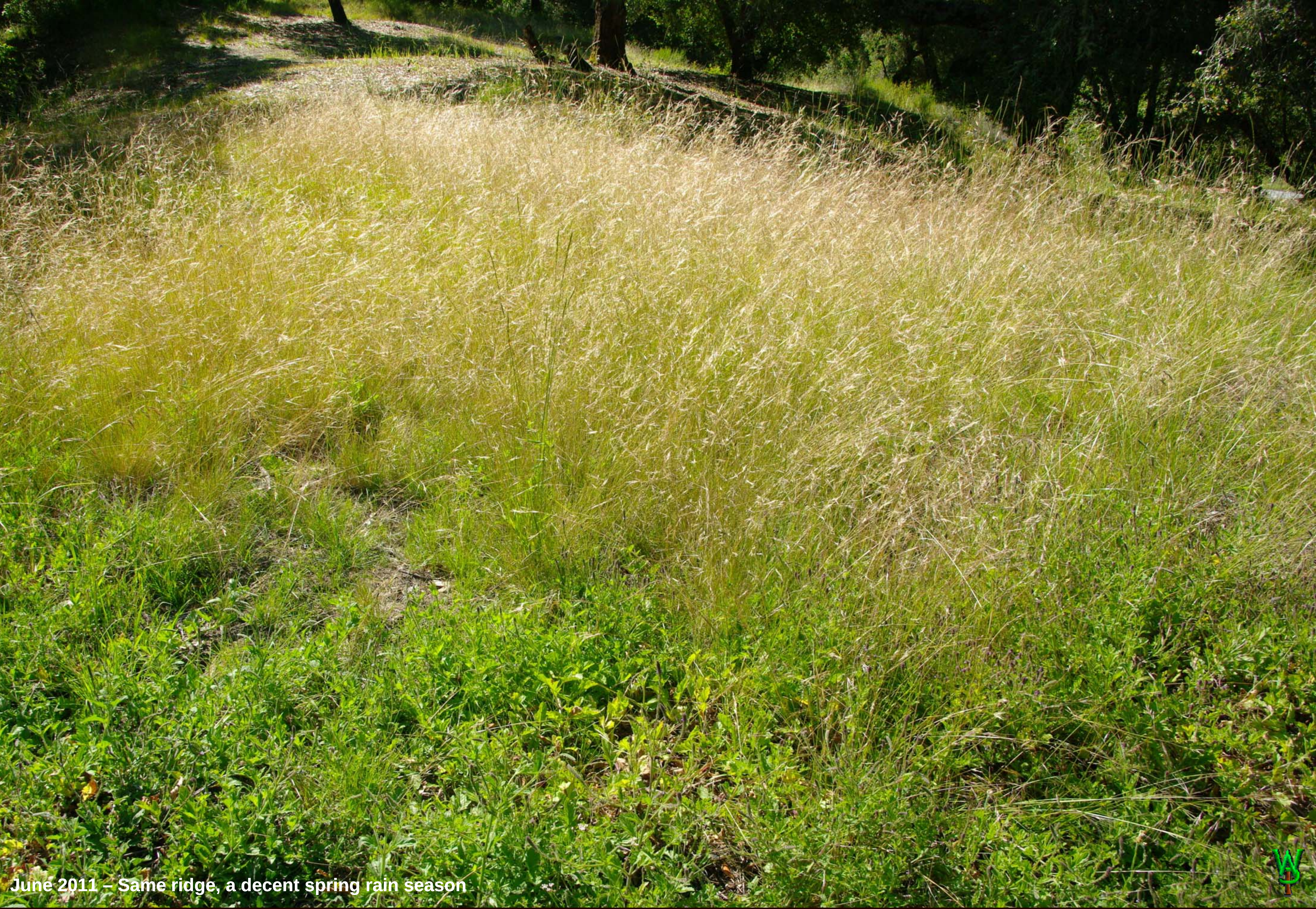
Even on our poor soil, once these brome grasses have inhabited a patch for several years, they can become quite productive. Dax sits over 3' tall. These (mostly) *Bromus carinatus* are from 2-4 feet. This forage density is on the order of 3,000lbs/acre.

June 11, 2010 – An unusually wet spring

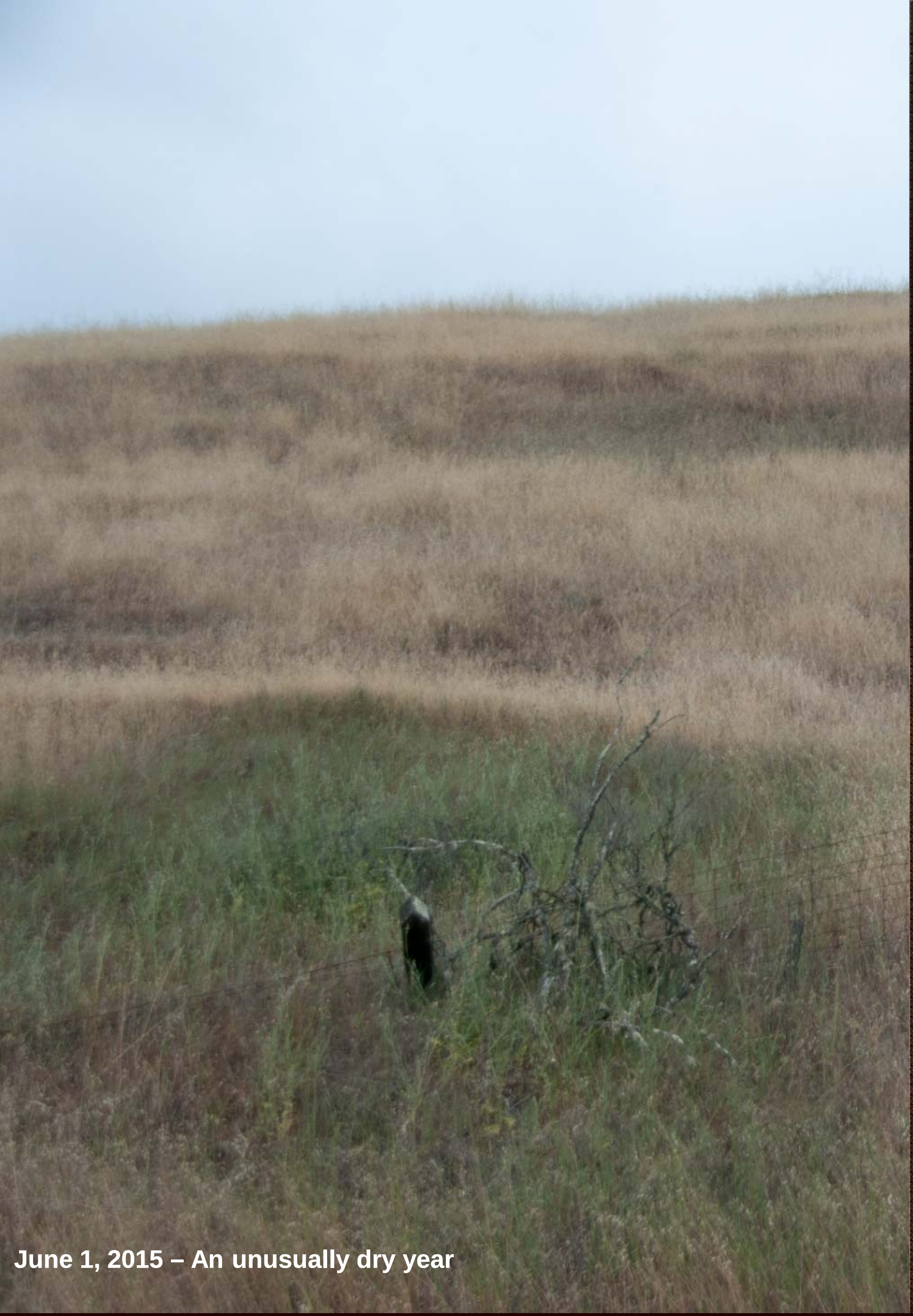


July 2, 2015 – After three years of drought

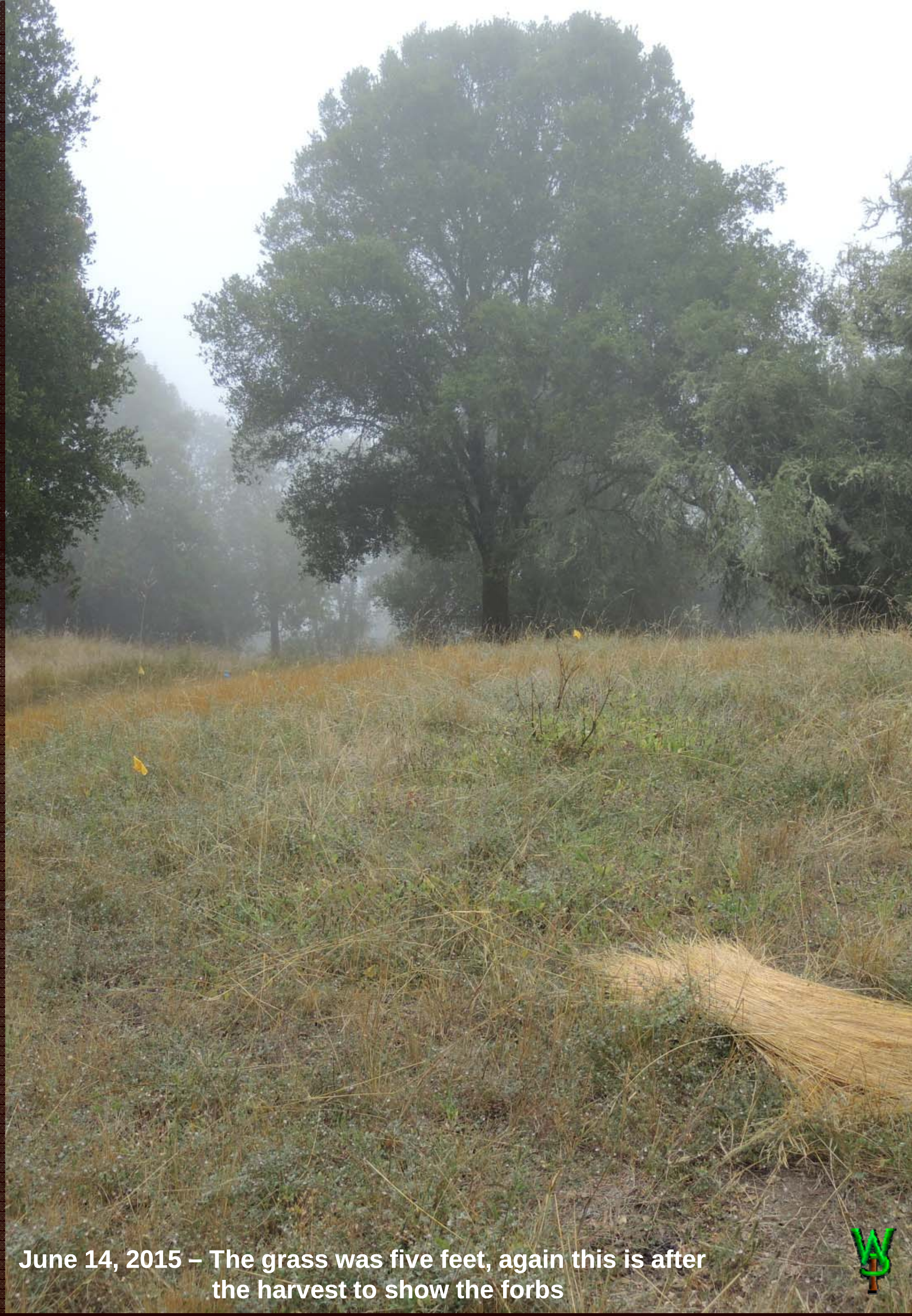
On the left is land belonging to The Land Trust of Santa Cruz in a marine climate in early June. The green patches are Italian thistle. Being at the base of an east facing hill, it gets more groundwater later into the year than our place does. The cover consists primarily of non-native slender oat about 2' tall. On the right is our ridge (and Alger), which received less than 2.5" of rain since mid-February and has is no ground water supply. Ours is an inland climate that is considerably hotter than Scotts Valley, and gets very little fog. The perennial grasses were harvested typically were five feet tall this year. The forbs are native legumes, primarily Spanish lotus.



Unlike the Land Trust's sandy marine climate hillside supplied with groundwater, this soil at the top of our ridge is just as sandy but still shows a cover of needle grasses, Verbena, and lotus. Although the grasses have hardened off seed, their leaves are still green.



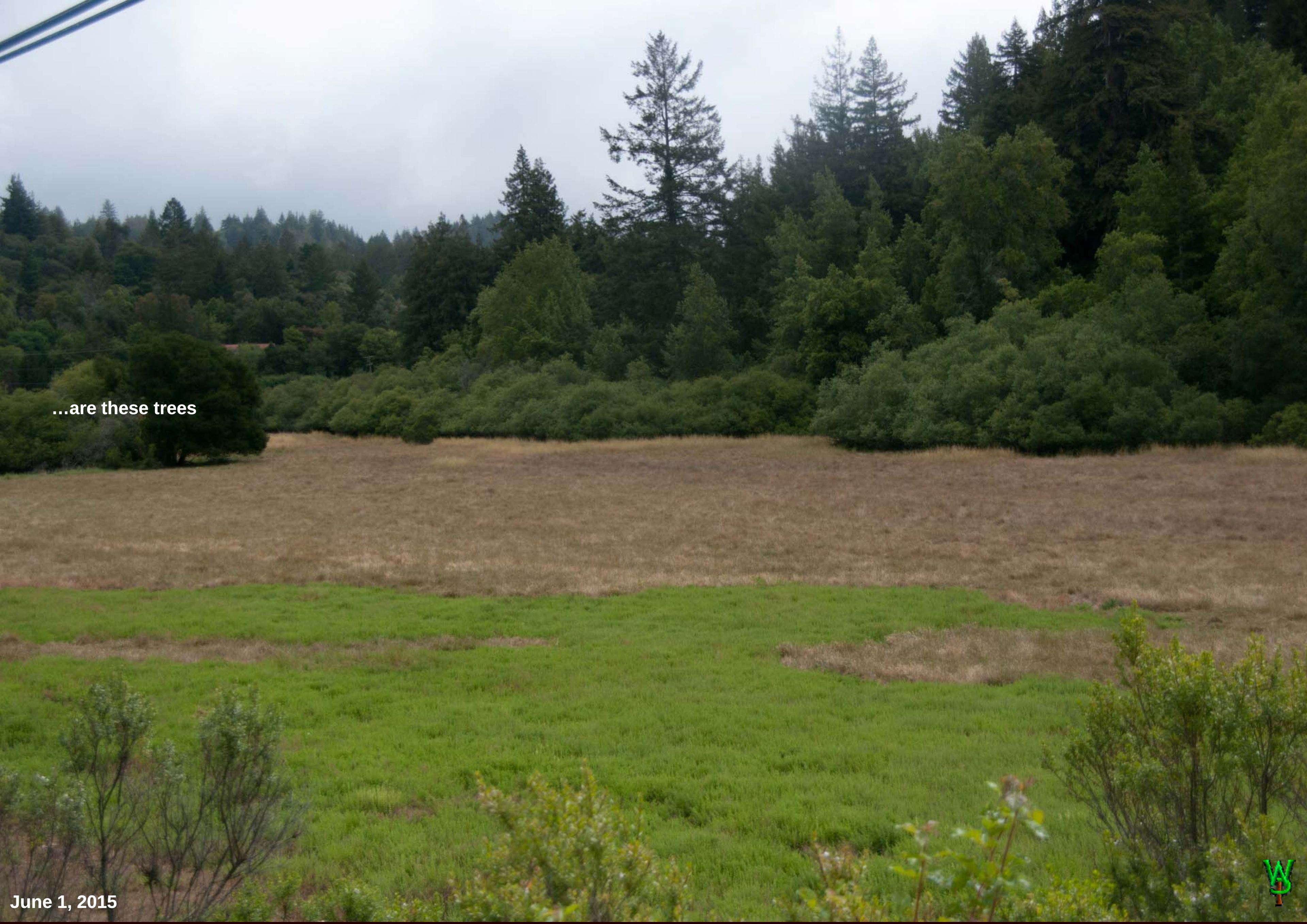
June 1, 2015 – An unusually dry year



June 14, 2015 – The grass was five feet, again this is after the harvest to show the forbs

Same two places at about the same season, this time during a drought year.

This photo was taken in June 2010 (an unusually wet year) across the road from the left image on the previous slide. This bottomland meadow in what is now Scotts Valley, CA has been grazed every year for probably 200 years since the Spanish brought their cattle to Rancho San Augustín. Note in the inset how rich in organic matter the soil is from a ditch dug just down the road.



This is the same Land Trust meadow in a drier year. The exotic weed in the foreground is pennyroyal *(Mentha pulegium)*. The meadow is still grazed, as it had cattle on it when I took this photo. The photos vary because of the rate of growth of brush along the County road.

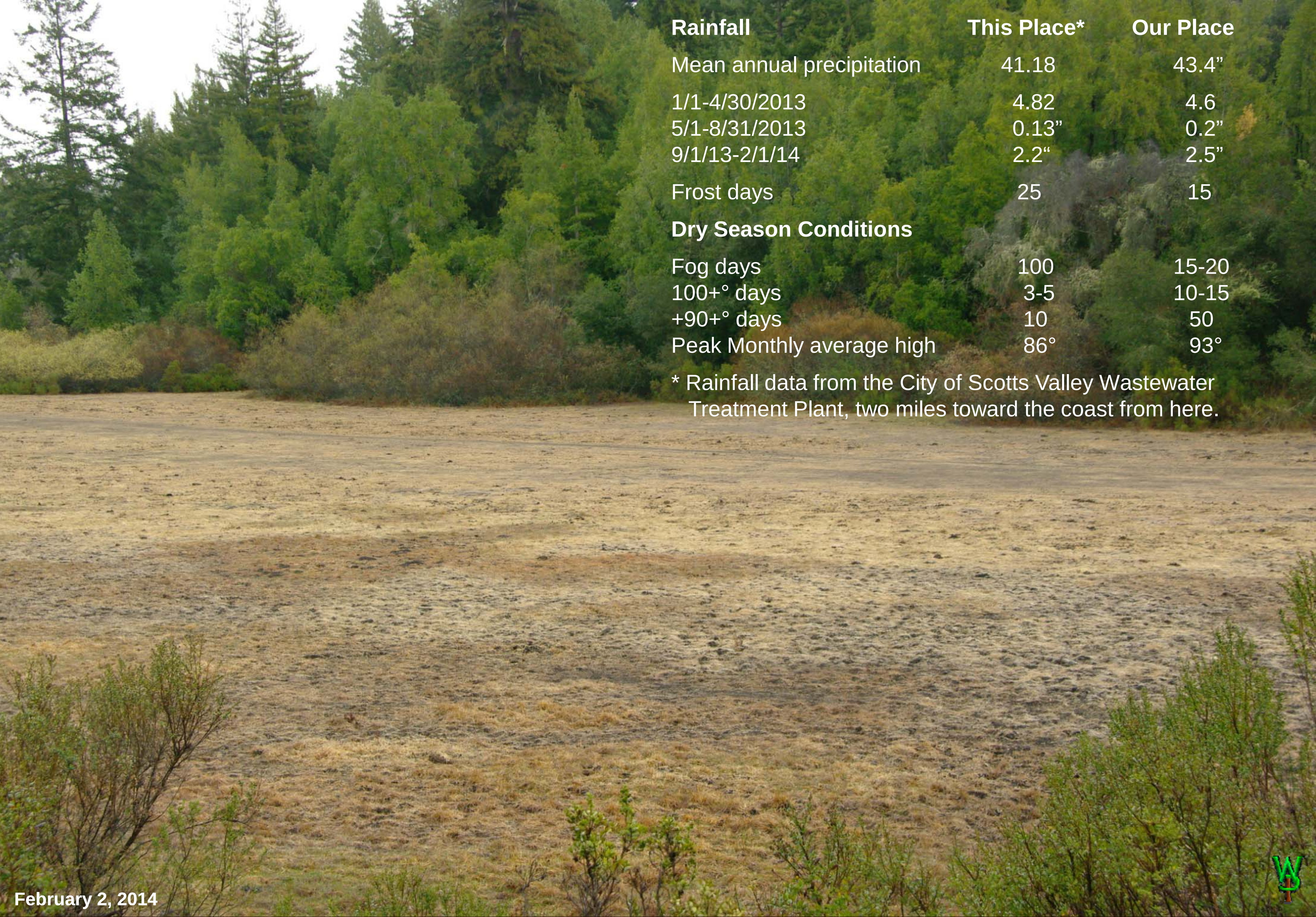
Same day, here at the Wildergarten.

You wanted greener? OK, that shot did have a lot of clover that was done, as are as the fruiting stems of the bromes. So it wasn't exactly fair. It still isn't, because this is a sandy ridgeline. It's still greener anyway.

This is the fourth week of July. Although these California brome stems and florets are dry, the leaves are still green.   Again, this is sand.

This is August.

And here we are in September, with our California brome grass *still* with green leaves. The groundcover on the left is *Verbena lasiostachys*. The forb in the right middle is slender tarweed (*Madia gracilis*).
Now that we have covered our place for a year, let's return to the meadow in Scotts Valley that looked so good.

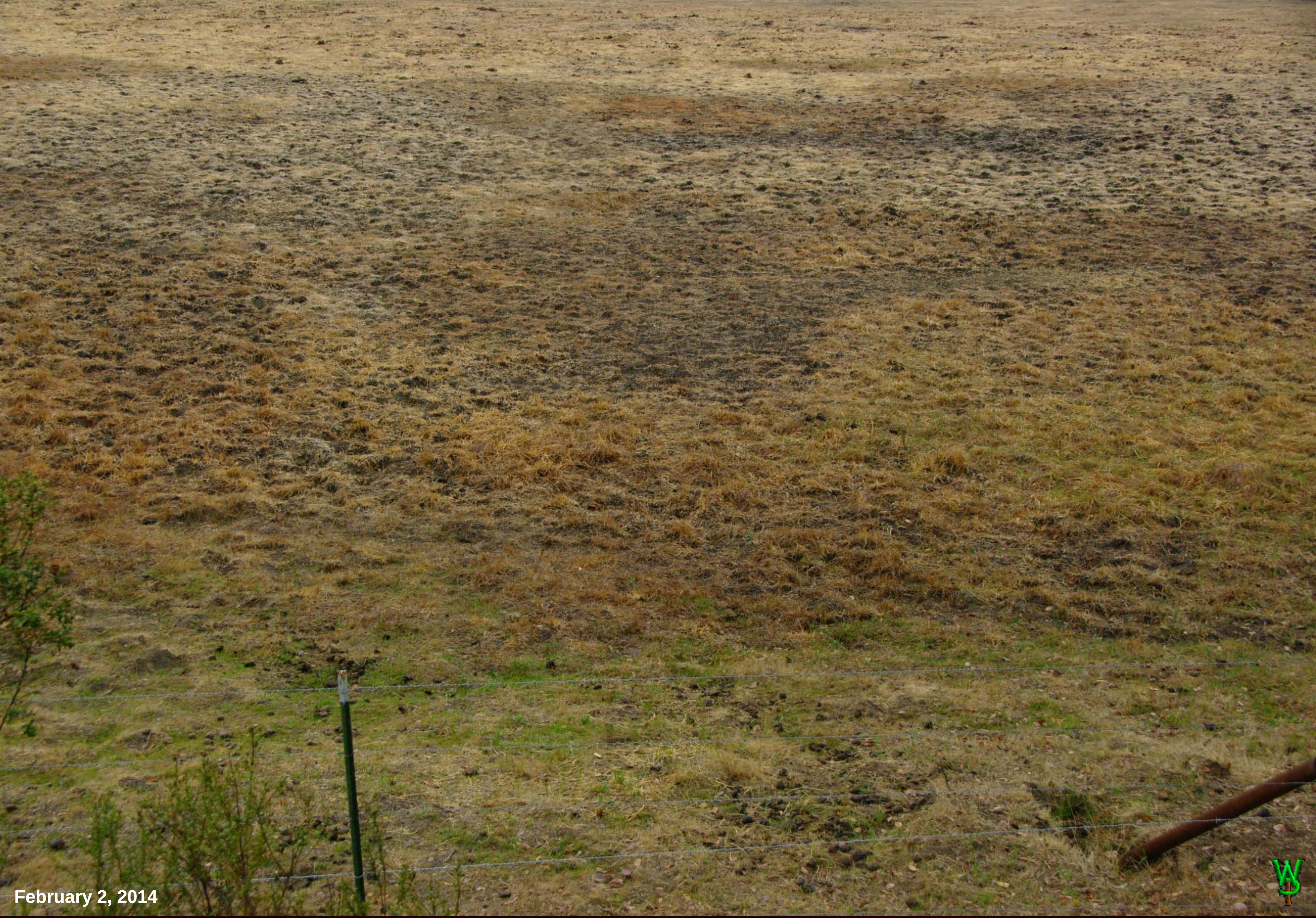


Rainfall	This Place*	Our Place
Mean annual precipitation	41.18	43.4”
1/1-4/30/2013	4.82	4.6
5/1-8/31/2013	0.13”	0.2”
9/1/13-2/1/14	2.2“	2.5”
Frost days	25	15
Dry Season Conditions		
Fog days	100	15-20
100+° days	3-5	10-15
+90+° days	10	50
Peak Monthly average high	86°	93°

* Rainfall data from the City of Scotts Valley Wastewater Treatment Plant, two miles toward the coast from here.

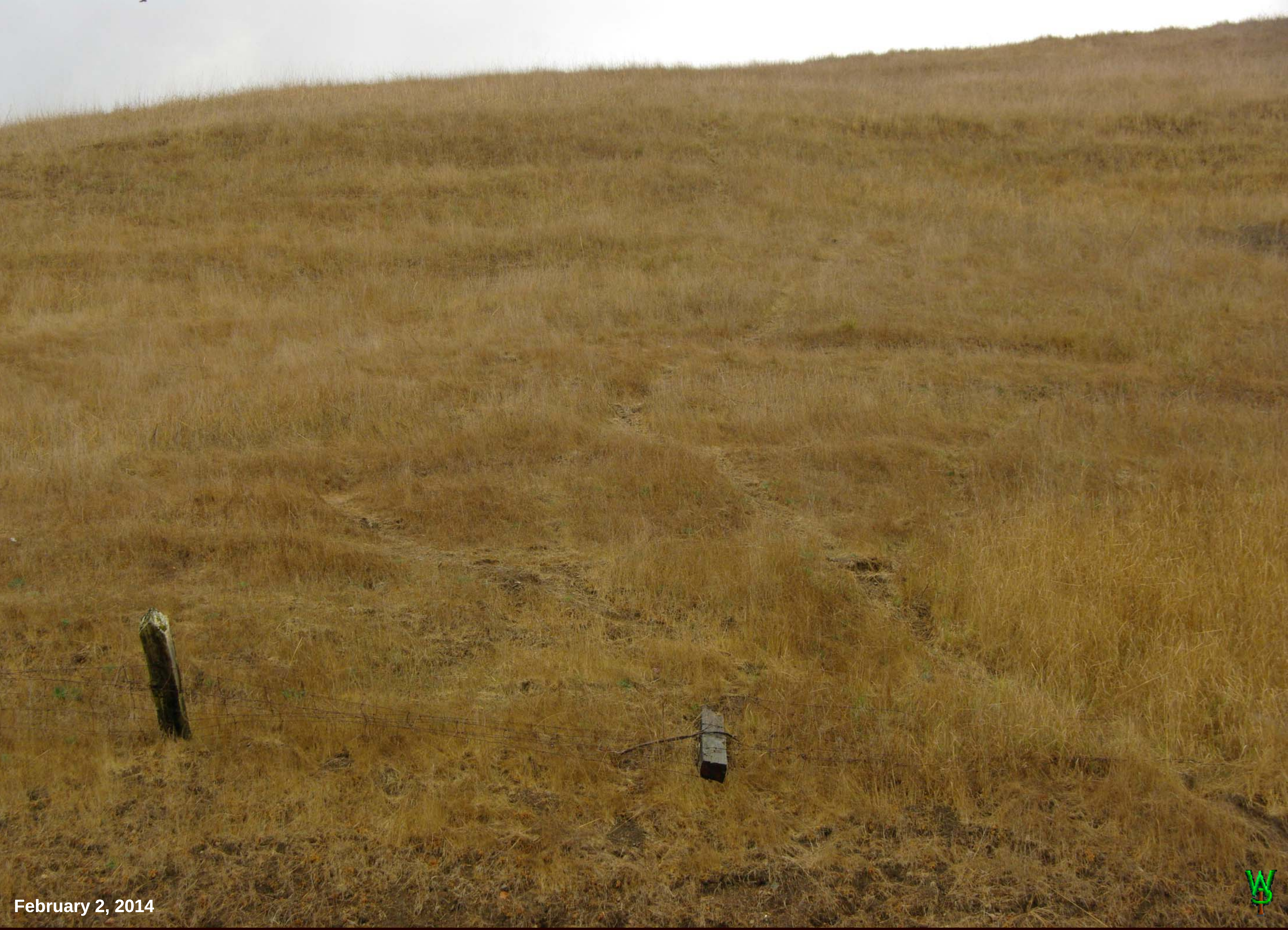
February 2, 2014

This field is comprised largely of annual grasses that are grazed every year. So this is not surprising, except that this is February. It should be green, but this had been the worst rainy season in 100 years. The few perennial grasses they had appear to be dead.



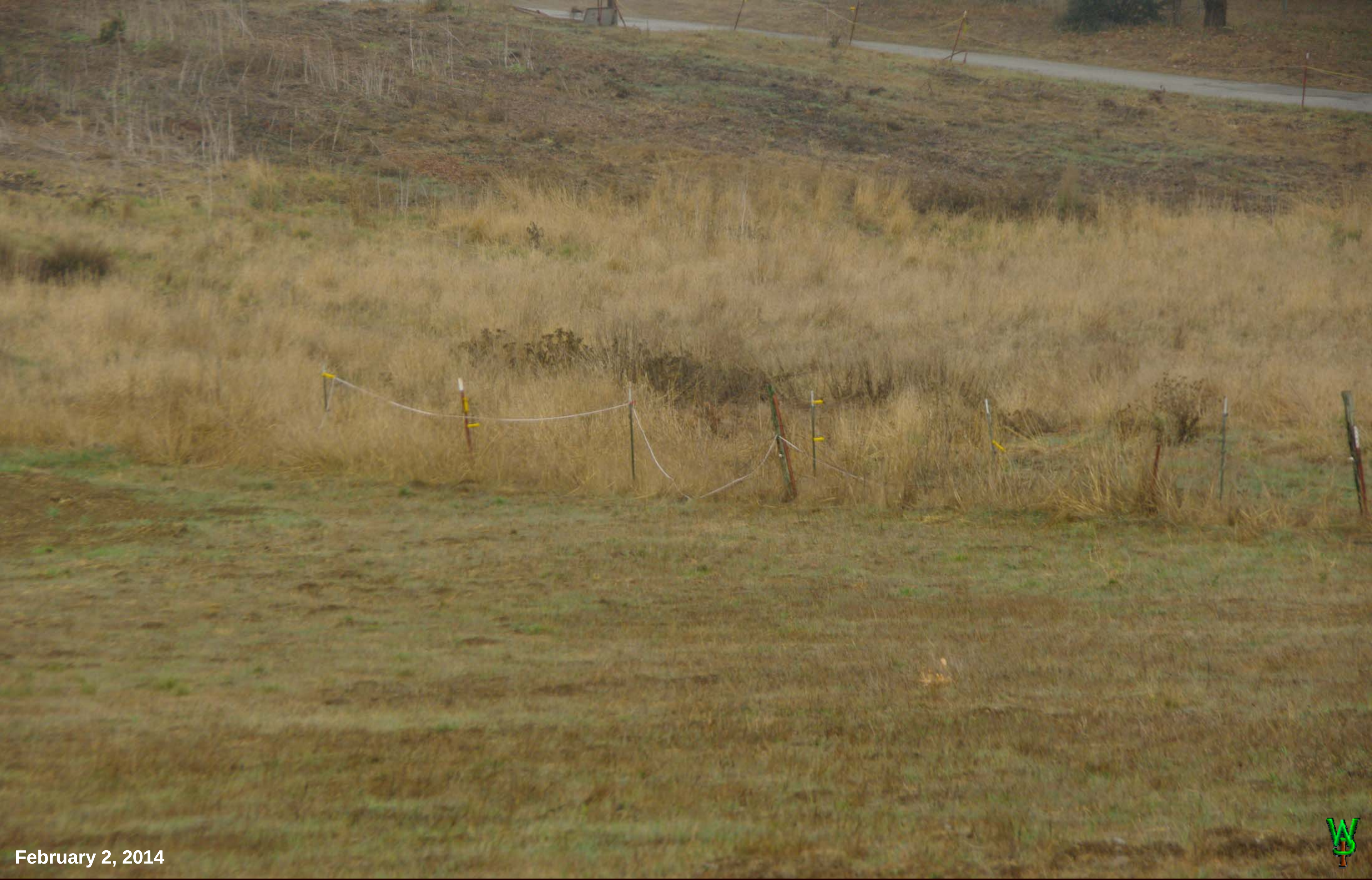
Here in Scotts Valley, the germination is terrible, despite the marine climate, wonderful soil with obviously adequate nitrate and regular disturbance.   It is colder down here than at our place, but temperatures had been unseasonably warm for the last month.

Yes, this is the same day in front of our house. Here are California brome, miners' lettuce, a blue witch *(Solanum umbelliferum)*, and some native blackberry I'm trying to kill. You see good germination AND bunch grasses that survived the summer drought, despite much higher temperatures, and despite much less fog. Nothing has been added to this soil, although my dog does pee around here at times. It has never been irrigated. Yes, you see water on it because it rained today for the first time in over a month.
I ran out to take these pictures before it could show any sign of having benefitted from the precipitation. The difference you see is real.



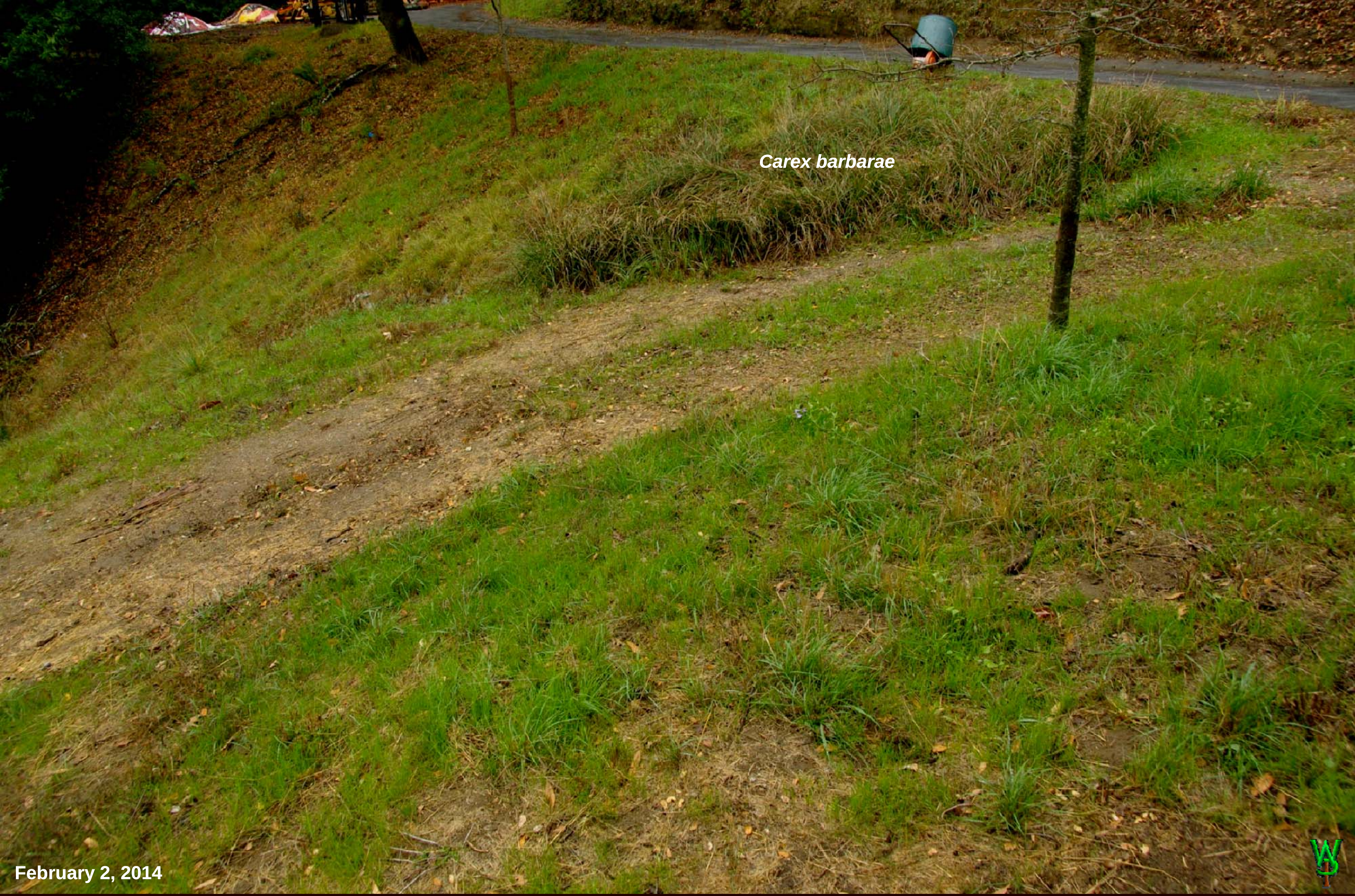
February 2, 2014

And again we have the hillside on the opposite side of the road from the meadow.   Do you see anything alive?

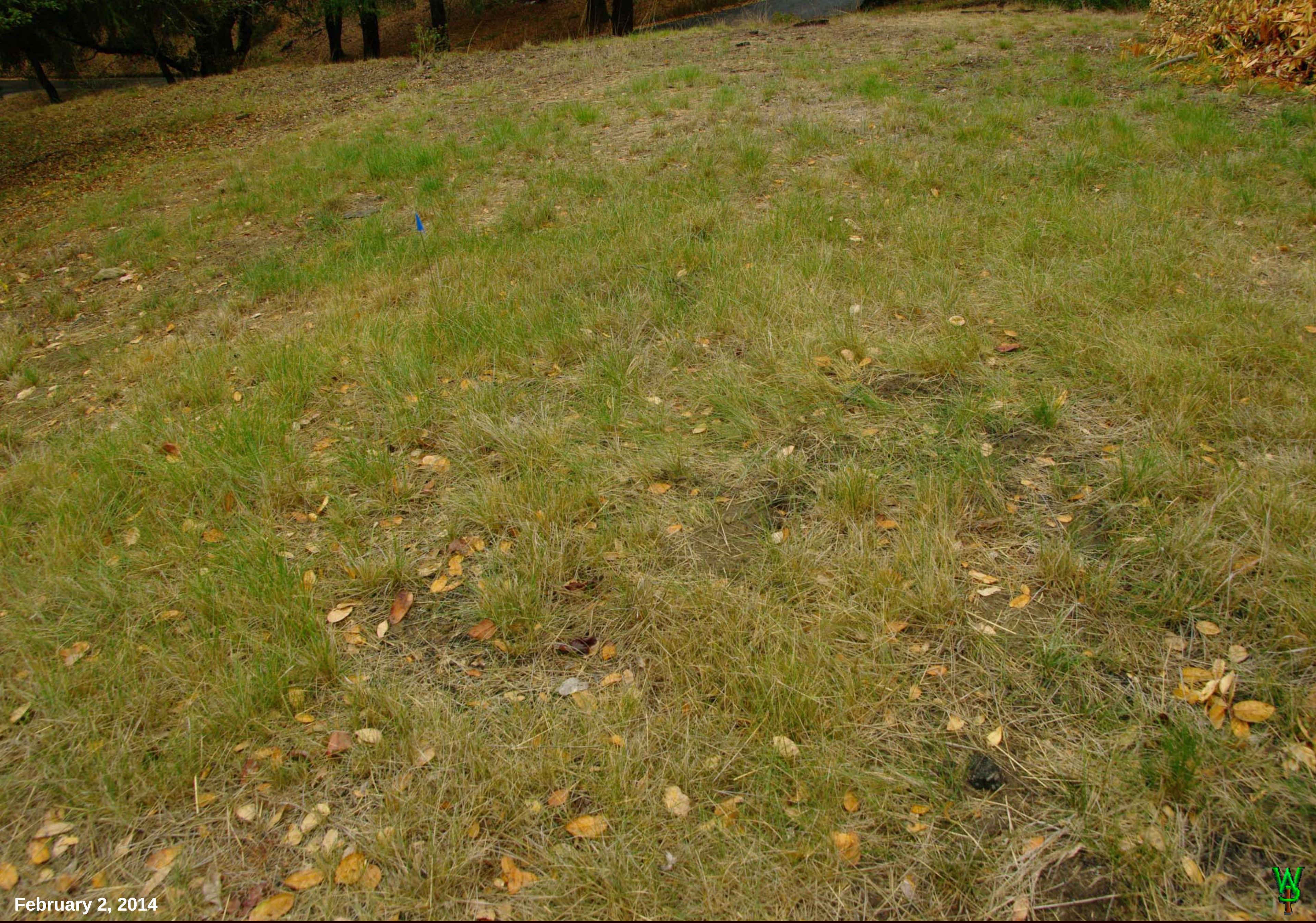


This is up on Summit Ridge about seven miles to the east of us at about 400’ higher in elevation, again the same day. It gets the same rainfall we do but is a bit cooler in summer because it gets direct winds off Monterey Bay (we are behind two ranges of hills). Meadows like this are hard to find around here because succession has run amok for so long. This field is usually grazed but you do see a patch that was not. Again, the soil is far better than ours. This is perennial orchard grass and annual slender oat, at most 2” tall, but as you can see in the background, most of it is bare dirt. So, how did our place do in the same drought?

You can see from how yellow it is that the soil nitrogen is poor. Still, they made it. Over the coming years, it will get even better.



It had been so dry, even the *Carex barbarae* does not look good. There have been three native grass species colonizing this stand of brome: *Stipa pulchra, Elymus glaucus,* and *Deschampsia caespitosa,* which I believe to be a successional phenomenon. All of them made it. All I did was mow it once, and weed it. There was no amendment and no irrigation. There is some shade in the background. There is no runoff feeding it because of the road above it. So, is it just the bromes that are so miraculous? Nope.



These are the needle grasses on our sunny hilltop the same day. This is a south-facing slope with no soil amendments at all.
It can get better, MUCH better. Just give me time.

This is the same hilltop with full sun in July of the worst drought year of my lifetime after two years prior that were drier than usual. The bunches on the burn spot in the foreground are *Deschampsia caespitosa*, a grass supposedly found only in coastal zones. One showed up here a couple of years ago and I have been propagating it. They were planted in March this same year. They are clearly still showing a tinge of green, having not yet gone completely dormant. My guess is that they will make it. If I get germination, I'll add the *Danthonia californica* this winter that also showed up a few years ago and we will all get to see what happens!

August 31, 2014

This that same *Deschampsia caespitosa* was planted here in late-March this year as but a highly-tapered 1" square plug amid the worst drought year in memory. Just as a test, I put it in a sunny spot on the south side at the very of the top of the hill. The only water until fall was 6" of rain in April and May. Needless to say, I did this both to make a point and to see if it would make it, as it is a nice palatable grass that doesn't make the nasty seed needle grass does. Here it is doing quite nicely. Can you see a possible reason why?

Every once in a while, I happen upon something completely unexpected. This photo went to scientists around the world although it is not obvious as to why. Well, this is the middle of **August**. Here are lush (and unusually large) clovers and lotuses popping out of the burn pile where I'd made charcoal back in late April. Although there had been an unusual rain at the end of June, that is not all of why this happened. The late burn meant that there were no competing plants to suppress the late season germination. Even when there was dew on the ground, the charcoal was always dry on top. Charcoal is a moisture sponge. A late burn hot enough to make hydrophilic charcoal might have been a way for Indians to dry-farm fresh summer vegetables from annual forbs by forcing germination at a later date. It would probably work reliably along the coast where the fog keeps things cooler and dew is frequent. This sort of happenstance observation represents the kind of thing one learns more easily when living on the site.

This is the *Danthonia* where it first showed up here. Propagating this grass and trying it along with the *Deschampsia* in an established sward of *Stipa* points to one of the key purposes of this project: I know of places where these species coexist. So I want to see what this native system can do when unimpeded by exotics toward identifying symbiotic combinations that produce abundant high quality forage that is easier to establish and care for. One downside to *Danthonia* is that it can be hard to germinate without scarifying the seed coat. The downside to needle grass is that it is painful to animals. The *Deschampsia* may not tolerate the competition. We'll see.

This is primarily *Bromus carinatus*, *Madia graciis*, some *Stipa on the left* and *Lotus purshianus*, along with various members of the Everlasting tribe with some rushes in the foreground. This area is a southeast facing fill slope that gets some shade in late afternoon. We just finished a week in which temperatures hit 105°. It touched 100° again yesterday. Our “coastal only” *Deschampsia* made it here!

There has been no watering here other than the one compost heap in front (there is a tarp under it), and the fruit trees in back. This site received an early pre-emergence treatment in October. Yet much of what you see here that is green are **annual** forbs. They germinated in March because the rains did not begin until February. The *Verbena lasiostachys* (a perennial) has for the most part gone dormant. The pink cudweed *(Gnaphalium ramosissimum)* is either flowering (in the shadier spots) or going to seed, but much (although not all) of that is also still green, as is the *Carex barbarae* on the right, which is again without water. Yet the amazing vinegar weed *(Trichostema lanceolatum)* (an annual) is still in bloom and lush, even growing in base rock, and they are full of bees. As you saw in a prior slide, it get hot here, but there is more clay in this soil than elsewhere on our property. There was also less evaporation from under the tarp, so a mycorrhizal fungus might have found some moisture for the vinegar weed; else, I don't know.

So, How?

There are some fundamental things about perennial grasses that may be at work here. When they go dry in summer, they sacrifice root zone from the ends back toward the plant. That may sound counter-intuitive in terms of accessing deeper residual soil water until one realizes that it takes water transpiring from leaves for them to make the sugars that keep root cells going. The plant effectively "shrinks," leaving behind dead leaves that constitute powerful reflectors of incoming infrared light. Those dead leaves also shade the soil, keeping it cooler and reducing the oxidation of organic matter. Yet they are also capable of conducting moisture to evaporate into the atmosphere. Solution? Shut down the roots to store water within a dormant core until it rains.

Every year, perennial grasses go through a cycle of sending their roots downward in the rainy season to grow, then sacrificing that root zone as the year progresses until it goes dormant sometime in mid summer, then to hang on until the rains come in mid-fall, or die. Yet if they don't send them down far enough, they don't have the resources after seeding below a dropping moisture horizon to build carbohydrates in the root mass as the ground dries.

I learned about this ***amazing*** experiment from Israel, in which artificially-induced drought stress in plants exhibited a cascaded response to from plant to plant. Five pots were set in a row with the roots of pea plants divided between adjacent pots, effectively making a chain. The first plant in the chain was chemically shocked into drought stress with mannitol and closed its stomata within a few minutes. Within an hour, the last plant in the chain had responded like the first. There was no transmission of mannitol between plants. I suspected that the "communications bus" for this cascade is fungal, in that when the plant shuts down, that "cringing signal" propagates through the plant tissue to its roots, thus affecting the fungal fibers that penetrate the roots seeking sugars. Lacking the sugar, the fungus reacts, probably no longer supplying moisture and nutrients to the next plant in the chain. The plant somehow reacts to that withdrawal, also signaling drought stress. And so on. Effectively, the drought response has the potential to propagate through an entire plant community.

OK, so what of it? Well, if a community of deep rooted native plants got the word to shut down early, it would do so before its roots had penetrated far enough to obtain deeper soil water in early-mid summer, nor would the mycorrhizal network have developed as much as it would otherwise. Where might that signal originate? From a shallow rooted non-native annual that goes dry far sooner than the native perennials. Effectively, it is a reasonable hypothesis that the way shallow-rooted exotic annuals defeated deep-rooted native perennials was that the latter responded to spurious drought signals.

Our California bromes did not do well at first, behaving much like annuals rather than perennials. As explained elsewhere, the seed was contaminated with an non-native annual "soft chess" *(B. mollis)*. Early on, the native bromes seldom survived their first year, effectively behaving like annuals. Every year, as I weeded out the residual rip gut and soft chess.

And How

the natives clearly greened up after weeding in late spring, even though soil moisture was falling as the season progressed. Over recent years, more B. carinatus have been surviving than ever as the exotics have become smaller in stature. As you can see, in 2014, they not only survived, some actually look like it was a normal spring despite only 2.7” of rain in 9 months.

Early on, I was wondering if the reason the bromes seemed to be harmed by the weeds was allelopathic, that the exotics were exuding some type of toxin. While I still think that may be going on, I am also fairly sure that there more to it than that. If this educated conjecture about the effect of “drought communication” is correct (I prefer to think of it as a cascaded set of reactions), then for a native grassland to function properly, it would have to be *extremely* pure as we now have here. Else one dying non-native annual grass would be the botanical equivalent of shouting “FIRE!” in a crowded theater. The problem for the hypothesis is that there are also annual grasses native to this area (notably *Festuca microstachys* (then *Vulpia*), also known to be allelopathic), although I do not grow them here (too hard to distinguish from non-native *F. myuros and F. bromoides*). One must also wonder if there are similar cascaded linkages between annual forbs and perennial grasses, as they are known to be netted together in a common fungal network as a means to distribute moisture and nutrients to maximize sugar and nitrate production. When the forbs go dry, why would the grasses still be OK if a drought signal was involved? Then again, if the forbs competed for water with the grasses, why did the grasses make it through the summer?

This is how ignorant we really are, because until Wildergarten, no academic investigator has had a fully native successional system with which to ask the question and measure statistically significant results. One would think the academic community would be excited to take advantage of such a laboratory, but so far they have expressed no such interest.

Needless to say, I am not at all interested in repeating the experiment by seeding my clean stands with annual exotic analogues to see what they do! I’d rather someone else tried that. The point is that I believe our experience and results here warrant *someone* taking a more serious look at this question of either allelopathy or drought communication instead of simple water competition as the reason non-native annual grasses are so effective at displacing native perennials.

As to detecting a signal, I have no idea how one would capture a microscopic phenomenon in something so delicate as fungal hyphae and their penetration into roots when the plant responds to said changes in minutes (maybe Werner Heisenberg was a biologist after all). So for now I think we may be stuck with processes of elimination and statistical inferences in isolated patches of a few hundred square feet. One might be able to make the distinctions by integrating signals from an infrared camera using standard digital image processing algorithms because of the changes in surface temperature due to changes in transpiration rates when stomata close.

Table of Content

Each line in the TOC is a link that opens the corresponding chapter in a new file

These are LARGE files; they do take time to load

Please offer suggestions and comments **HERE**

References are **HERE**