Rationale for Our Project: Weeds + Succession = Mass Extinction

June 2014 – Keep this image in mind, as we approach the end of the chapter

This chapter starts with how weeds and succession are depleting the genetic resources of "natural" landscapes. For the first century after the Spanish invasion, most of the lands in the Bay Area not in agriculture were grasslands wide open to the exotic plants, principally slender oat *(Avena barbata)*. Native seed (particularly annuals) degraded, forced to remain dormant in the soil because of exotic dominance. In areas with regular disturbance from cattle, some few natives were able to make seed. Above is just such a former ranch, Stanford University's Jasper Ridge Biological Preserve, which resembles conditions before development in most of this region. As ranching was abandoned, succession took over. Brush and forest invaded largely exotic grasslands.

Wildergarten 6.2

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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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Going, Going…
…Gone?

March 1990 – Working from right to left… I cut a lot of trees

To recap the previous site history chapter, under Indian management, our property was dominated by annual forbs, bulbs, and grasses. Weeds invasion commenced in 1791 when the Spanish built the adjacent road. Two years later, the Spanish ban on Indian burning allowed succession to progress: first brush, then broadleaf forest, and then conifers. The place was logged around 1890, taking a half dozen trees. The subsequent slash fire started three stands of redwood. In about 1920, Ed Fenn terraced the hillsides for his apple orchard, abandoned during the Great Depression, after which succession commenced again. When we started in 1990, the native brush understory was dead and gone, oak woodland was overpopulated and going decadent, and conifers had been invading for 50 years. Exotic French broom dominated 70% of the oak understory while exotic acacia and eucalyptus dominated 25% of the forests. Effectively, the place was 75% weeds and the rest was redwood. In total, there were perhaps 60 visible plant species, of which about 50 were native: mostly trees, ferns, and a few senescent shrubs. But when it came to the seed bank, things were MUCH worse, under those forests it was a weed bank; the native seed bank, for the most part (but not all), was long gone.

Nothing Succeeds Like Succession
Why "Native" Is Not Enough

October 2013 – All of these plants are native

Besides invasive plants, this image demonstrates a more insidious threat to the native plant system. It affects soils, fungi, bugs, ground-covers, and the animal food pyramid that depends upon them, a threat that goes almost completely discounted because "it's Natural."

In this region, the process of “succession“ is typically over-simplified, with grasses displacing forbs, then comes brush, broadleaf forest, and finally a “climax” conifer forest. Above is an example just down the road. Each successional stage dies as it is shaded out; manzanita succeeds to oak and madrone trees, and they are shaded out by Douglas fir. Hence, other than the fir, none of these plants is healthy. This is worse than the mere fuel bomb that it is. In these mountains, succession run amok is doing more damage to the plants that provide wildlife with **food** than any other environmental factor, more than weeds or development.

June 2010, a mile down the road from us.

In the 1940s, this was a grassland (a cattle fence is still visible in the foreground). Once grazing had been abandoned, dense brush invaded without disturbance, then these trees all started together. As the canopy rose and tightened, the brush died and rotted. This forest is similar to the way most of ours was, with slender, weak, and unstable trees all about the same age except that our understory was full of 6-10 foot tall French broom. This phase in even-aged forests is called “stem-exclusion,” in which canopy closure, water competition, and leaf litter inhibit other plants. Under aboriginal fire-management, conditions never reached this point.

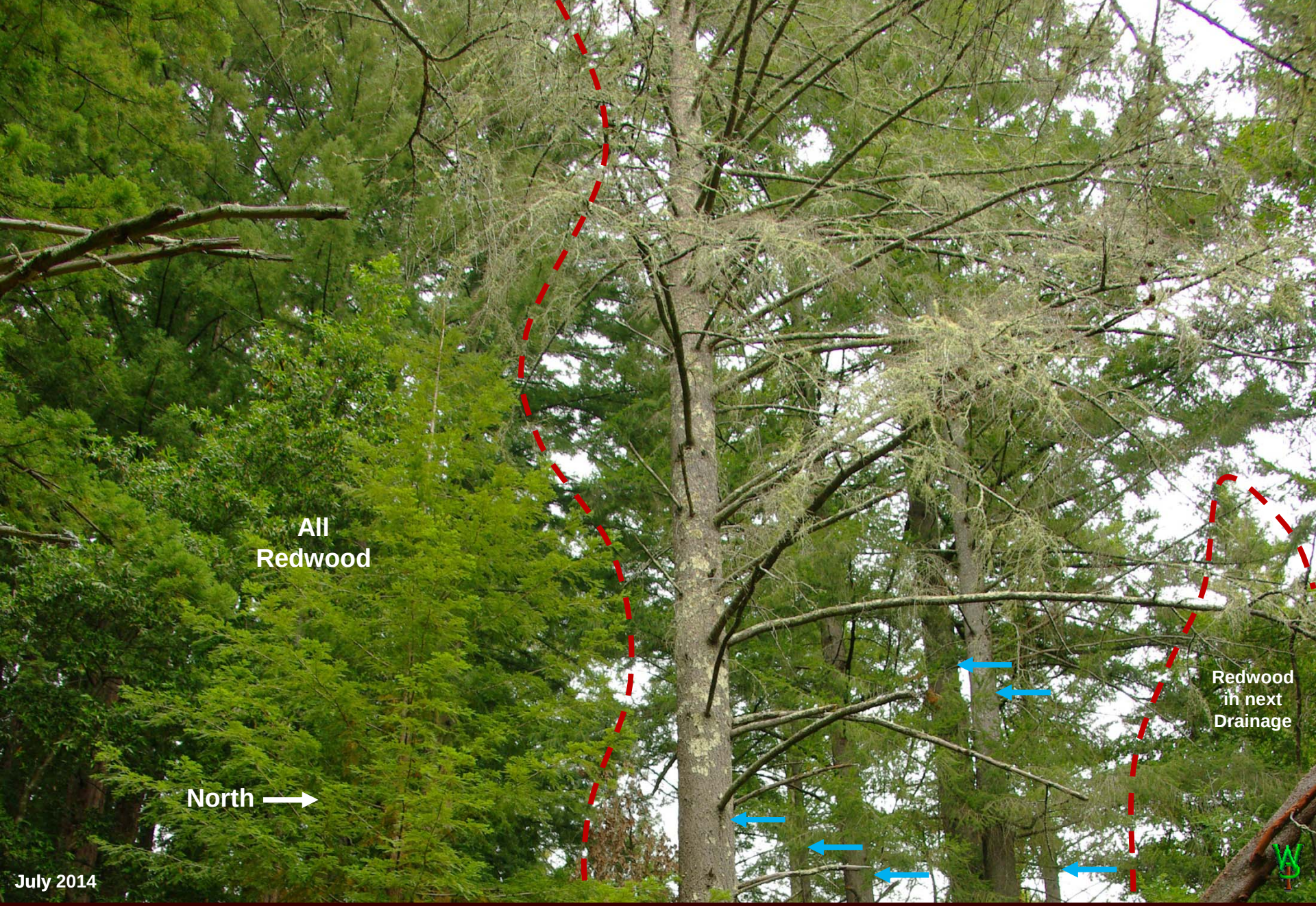
So, kill broom and thin it, right? Well, that's what we did, but it isn't easy, and it certainly isn't cheap. One of the things you learn is that the "best" trees are hardly that. So in a way, this forest had to start over, but I did not want it converting to a grassland (too hard to weed) and that means shade management as new trees get started. How to do this is not well understood, as almost all forest research is into how to make more construction lumber, not low-maintenance species richness.

Thin it, and you do get a response. Native groundcovers do recover. Weeds come up too. Another thing that happens is that you get more trees. Lots of them. The **red arrows** here indicate tree seedlings. Imagine ALL of these seedlings growing to full-size in such a small area. I cull most of them, or it wouldn't be healthy, would it? "More trees" requires frequent remedial action, or else.

This is “else,” less than 10 years’ growth. This is what you would see if I let the scene in the prior photo go for only another 2-3 years because that area gets a lot more sunlight than here. It doesn’t stop choking itself unless somebody stops it.

Like this. Yes, this is the same area. Nice **oak sapling** isn't it? Balanced shape like this is unusual under crowded conditions but crowding does tend to produce a stem rather than branching lower. The job didn't stop here either. The unstable madrones went next.

Now there are roses, iris, hazelnuts, California tea, yerba buena, poison oak, blackberry... It's starting to look like a forest! The goal is a fire break and a space in which the remaining fir can get enough light to stay alive but grow slowly. I don't want too much light here, lest grasses invade, which makes weeding difficult. I must confine grassland biodiversity to what I can handle. Management is not optional.



If I don't thin the oak woodland, invading fir would take over. That doesn't mean succession is finished. As the fir matures and the hardwoods die, then redwoods invade. Both conifers keep growing until water competition and shading by the redwood renders fir susceptible to bark beetles. The forest then succeeds to redwood. Guess what redwoods do?

Without disturbance, redwood proceeds to a dominant monoculture too! Yet paradoxically, they require disturbance to germinate. Redwood had never been this far up the hill before a slash fire in the early 1900s subsequent to logging down slope. In other places here, redwoods have started in gopher mounds. Hence, redwood invasion without broad scale disturbance is slow, but it does happen, as you'll see in the chapters on forestry. As to whether they displace other vegetation or not, the reason these survived into large trees is that there was no fire at all for the next 40 years. Now that they are established, a monoculture is virtually assured.

The common belief that redwoods always tolerate a fire beautifully is a myth held by the “fire-retarded.” *How* it responds depends upon what conditions are when it burns**:** seasonal moisture, winds, species composition, stand density, age distribution, solar aspect, local micro-climate, year-to-year weather variation, and the history underlying the seed bank as influenced by weather conditions the next year… all place determinative influences on the response of any system to a fire. You wouldn’t want this many trees here.

Thinning redwood eventually makes the situation for biodiversity worse, *unless* somebody deals with stumps. Experiments here indicate there may be a few but limited ways to manage this problem. If they are left alone as “Natural” then early successional annuals will not have the opportunity to reproduce. Let succession progress long enough without disturbance and the dormant seed of the early post-disturbance system dies. They become locally extinct. So, weeds and succession, until there is a catastrophe.

Weeds & Succession…
…Then, Weeds!!!

August 2014 – Star thistle invading what is still a catastrophic fuel load.
Leave this as dry standing fuel, and the next fire will likely be hotter.

The US Forest Service effectively bought the Sierra Club's fire policy, holding that "fire is Natural" and therefore simply "inevitable." While partly true, one can at least temporarily improve the outcome of a future fire with selective logging, which the Club does not willingly allow. Accordingly, in this overstocked stand of pine after the catastrophic Rim Fire near Yosemite (above), weeds sprouted along the roads with neither the USFS nor the Sierra Club doing anything to stop them, as if they were "inevitable" too! The star thistle won't stop here. Whatever they might do now will cost much more and be much more damaging than thinning, selling the logs for pre-emergence herbicides along the roads, and then burning it. Repeating disturbance with weeds present usually makes things worse.

And More…

Like this. This field of exotic yellow sweet clover *(Melilotus officinalis)* is in Yellowstone National Park. Forests, brush, agricultural fields, rangeland, it doesn't matter**:** If exotic plants are present in the seed bank, they typically make gains with disturbance, just as with this monoculture. Yellow sweet clover makes a decent forage. Bison like it. Park Service customers like Bison viewing so the Park Service allows the Bison to overgraze, effectively repeating disturbance at high frequency in the belief that their numbers will be self-regulating by lack of food. To anything that requires sagebrush habitat however, this situation is a spreading disaster.

Increasing the rate of disturbance is no help. Disking this mustard annually extirpated ALL of the natives here (i.e. they're gone). Eventually, the native seed dies and native plants are then extinct and their fungal and insect associates with them. That may not be a bad thing here, but we do need *some* places where the native system still works or we will lose the plants, fungi, insects and much of what depends upon them (such as migratory birds), and the genetic basis of the soil system. Not to mention forage for wildlife.

January 2013 – There had been ample rain by this date that season

Late May, 2018

Compare the obvious differences between these two young bucks**:** Above you have a scrawny yearling on Santa Clara Valley Open Space Authority property published because they were the “best” they got in 10 years (along with photos of starving predators). Below is a healthy two-year-old on our place. Look at the hips and shoulders. Look at their coats. Look at the forage. There had been ample rain in Nov-Dec 2012, so there is no excuse for the OSA. Forage quality means everything to wildlife. But does it *have* to be native? Many California native plants are toxic, smell bad, and have coarse textures or spines because they had been grazed heavily for so long that they adapted resistances to grazing pressure. The funny thing is, deer are adapted to need it that way, else their skeletons grow weak and out of proportion.

The two-year-old below was born here. His herd of some 4-5 does stays here because there are gobs of tasty things to eat. Acorns are still chief, even at this time of year. I need these animals to eat them; else my meadows are quickly saturated with scads of tree seedlings I get to cull. So I cut trees to make more forage so that they would stay to eat more of a smaller crop of acorns (see the chapter on forest understory).

This buck below along with 2-4 other deer comes by this spot spending 10-20 minutes here every day. This being almost June, the acorns are mostly gone. Yet there will be plenty of groundcovers to eat through the summer, while after that it’s largely browsing on brush. Clovers and lotuses (foreground below) are excellent sources of protein for ungulates such as deer. These plants don’t germinate well with exotics present.

So I thin and weed forests, the native plants grow, and the deer grow on them. I raised this herd. If they overpopulate, can I eat one? If they were my goats I could, but the great collective (“we”) own all of the deer, not the guy who brought the land back to life that supports them. I would have to pay a fortune to “our” bureaucrats for permission to eat animals I have spent the time and money to feed from birth.

But what if we burn a native system? Would that bring back forage? Often not. Above is six years after the Croy Fire not far from here on land belonging to the Mid-Peninsula Open Space District ("MidPen"). Do you see yummy forage for wildlife? No, the successional system did NOT simply restart from the beginning. Higher order plants (trees) reproduced seed that dominate annual forbs. If it burns again, whether it will just 'clean things up' or be a carpet of trees ready to blow up again is unknowable without extensive depth of knowledge of the likely responses to specific conditions. A complete understanding might take centuries. "Nature" doesn't care what happens after a disturbance. If what you want is biodiversity or forage quality, fixing this takes the kind of intensive multigenerational management MidPen dispossessed in the first place and to which it is still opposed. What we'll eventually get will be "Natural."

Like this. This is Mesa Verde National Park, which has deliberately been burned repeatedly. Yet here it is dominated by exotics, effectively an advanced case of the previous slides. Miles of cheat grass and musk thistle is not at all what most people think of as "Natural," despite that using fire is sold that way by the Park Service. But then, there are some 6,000 exotic species in National Parks.

July 2010 – The base of the Hamilton Range north of Paradise Valley, NV, still home to a few big horn sheep. The brown areas on the lower hillside are exotic cheat grass *(Bromus commutatus)*.

To recap, "Leave it alone" and even if the genetics of the landscape are all native (even if there are any places where that is true), once there is a disturbance, higher-order plants regenerate or germinate simultaneously with post-disturbance annuals. As the higher-order plants develop, they depress germination and reproduction of native annuals until there is another disturbance. If exotics are present, or are in the seed bank (and they usually are), the exotics make gains with each disturbance. One can witness this process even where "stringent" standards are already in place (as above). Repeat the cycle and eventually the natives gradually go extinct, including the higher order plants. During the process, forage quality, wildlife habitat, and soil productivity typically decline. But is this just some hand-wringing theory on my part about mass extinctions? Well, let's take a quick look at our experience here at *Wildergarten* of what has recovered and what is still lost, and thereby get to the central point of this chapter.

"Native" Is Not Enough

January 2017 – Consider the complexity in this photo; I remove tiny and fast maturing weeds such as *Cardamine hirsuta* or *Cerastium glomeratum* from the understory of these clovers… acres of this

Here at the *Wildergarten*, we deal with succession and weeds, but now we get to the bigger problem I learned about only much later**:** We started with about 60 visible plant species, of which 10 were exotic. Our plant species list now documents 355 visible species, 133 of which are exotic (of which 25 are now eradicated). In other words… Succession and exotic invasion had crowded out 172 out of the 222 native plant species now visible on this property, a 78% loss. Some of them were in the seed bank and those made it to reproduction. Many weren't and didn't. Many haven't been seen anywhere around here for decades. That's the point. We found what *wasn't* here that we know for certain *had* once been here and has not since returned.

According to John Hunter Thomas' 1964 *Flora of the Santa Cruz Mountains*, there were 5 native annuals found within less than a mile of here that in 29 years I have not seen anywhere within 3 miles. CalFlora.org adds another 5 from the Glenwood surveys. The blue *Gilia achilleifolia* – (above) is ***not*** among those counted as missing. Yet this photo depicts only the second time I had ever seen any in the area. Gilia, now rare, was once a dominant annual on Bay Area hillsides. It makes a wonderful livestock forage. Altogether from various sources, there are 16 local annuals in our immediate area that have not been recorded here since 1953. Most are probably locally extinct. The situation is that dire, like this is above. Don't see why?

This is the same spot where I got some of that Gilia seed but three years later. The reason the Gilia had come up here was that there had been a small landslide exposing native soil. What you see here now is more typical**:** exotic rattlesnake grass (Briza maxima) and a French broom seedling. Both were brought in by County roadside mowers because “environmental” activists won’t let them spray. Do you think I’ll ever see Gilia here again? Do you think I’ll ever have another opportunity to obtain seed from a local variety of ANY native plant here so that I can save a locally adapted variety of the species? I wouldn’t bet on it. Along this road, I have seen five species disappear under weeds in only 15 years, two of which I managed to collect and propagate successfully.

May 2015 - Bulbs, grasses, and herbs growing together

Grasses typically follow forbs as successional species. Together with forbs, pastures and savannahs once dominated all but montane coastal California. Among the native monocots (grasses, lilies, sedges, and the like) listed for this area, I don't recall ANY grass species of any kind that was still here and reproducing when we bought the property (although I can guess at a few). There was one patch of sedges and no rushes. There were possibly a few iris, but no lilies. After thinning, 28 exotic grasses were either in the seed bank or returned. Of the 28 exotics, 7 are eradicated and the rest are very close to that. Today, we have 35 native grass, rush and sedge species, with another 12 other monocots, mostly lilies. Grass seed is mobile on animals while the lily seed bank was still viable.

March 2018 – This is typical of the intense species richness of a high-disturbance location here at the Wildergarten.

Among the 145 native dicot herbs on our species list, only five (5) were still reproducing (barely) when we moved here. As our project progressed, an estimated 23 came up from the seed bank and 86 immigrated (each a guess based upon how they colonized). Over 15 years I found 6 more locally with their seed germinated here. In other words, there are still 30 species recorded in this area I have not found, 8 of which have not been seen here since at least 1953, and of those 6 not since 1914.

Among the 32 native shrubs on our species list, 15 were still here, of which 10 (2 above) had fewer than 10 plants each. Once I thinned the forest and got our 10-acre French broom infestation under control, 6 more came up or in on their own (usually on the edges of burn piles). It took a decade to find the next four. As of today, I'd say that 7 of those that have established are still not well represented and thriving. I'd like to find the other 7 someday but none have been reported for a century.

In 2015, after 5 years of looking, at last I had found a very few canyon gooseberry bushes *(Ribes menziesii)* still alive in a small opening in this forest about 1.5 miles from our place. The foliage was thin, with sparse leaves and no fruit because the canopy above was so dense. Like the Gilia, I transplanted a couple into cages and they did great until the deer found them, pushing over the cages to get at the lush foliage. They died. Scarcity focuses browsing pressure on those few tasty individuals that are left, just as depleted animal prey species can be caught in a “predator pit” unable to breed sufficiently to maintain a sustainable population. Given that I had failed, had I done the right thing in the attempt? I went back to where I found them in 2015 to see if there were still any left alive. No. Since then, broom, bedstraw, South African veldt grass *(Ehrharta erecta),* and forget-me-nots have invaded the area. The latter two will assure eventually that whatever canyon gooseberry seed is still here and still viable, never gets another chance.

To recap, we started with about 60 plant species, of which 50 were native. Two exotics (broom and acacia) dominated 70% of the property, with much of the broom under native tree cover. Some weeds get so big (Eucalyptus above) that even higher order plants were being crowded out. Eucalyptus had shown significant germination after a small fire when an old cabin had burned down here in 1979. Total exotic domination of this landscape was only a matter of time and disturbance, until we got here.

At which point, there was a disturbance. Since thinning the native forest, taking out the Eucalyptus and Acacia, and removing the French broom cover, 134 exotics have been catalogued, of which fewer than 5 arrived since we started construction. In other words…

Over 100 exotic species dominated this area long before that tree cover established at least 50 years before we got here.

Deschampsia cespitosa **is regarded by botanists as a coastal grass. Here it is in late May 2015 doing just fine on the hottest, driest, sandy hilltop on our property after two years of severe drought.**

This beautiful grass, appeared for the first time in 2019 (there are 5 so far!). It looks to be *Calamagrostis nutkaensis,* a species thought to be exclusively coastal in this area

The species list cited in this chapter to estimate the 35 “still missing” native species is comprised only of what I have seen or what botanists have recorded. Yet when University of California botanists started the Glenwood surveys in the late 19th Century, this plant system had been degrading for 100 years. It is unlikely they found every remnant species back then even if it was still breeding. Some of the native plants that showed up here are still regarded as exclusively coastal plants because those are the only places they can still be found (above). Yet these natives do fine here under our hotter and drier conditions than are found at the coast, and I can’t imagine the seed had never been here in 10,000 years of climate change and Indian transit along the tribal trail.

Hence, by the time we started in 1989, succession and exotic invasion had crowded out 197 out of the 247 native species currently estimated to have been here. **These data suggest that this area was headed for a loss of about 80% of local biodiversity**. "Preserving" conditions like those would be insane, but that is the dominant prescription among the non-profits, foundations, bureaucracies, and academic elites claiming the authority to direct everybody else not to do anything about this disaster.

This is typical of how they are doing. This is the world famous Stanford University Jasper Ridge Biological Preserve I asked you to keep in mind as you began reading this chapter. Here, soils are undisturbed (it was a ranch when Stanford got it). Here, trace minerals are adequate. Here, the groundcovers are mostly exotic. And here, the 2014 operating budget was over $1 million. Here is where Dr. Paul Ehrlich saw to it that the Bay Checkerspot butterfly *(Euphydryas editha bayensis)* was listed as "endangered." Scientists leapt upon millions in government cash, attributing its decline to development lacking connecting corridors, climate change, pesticides, weeds, nitrate pollution… but not one is restoring the native plant species checkerspots need to reproduce! Dr. Ehrlich claimed more could be "learned" from watching the species decline than by trying to save it, so he never *learned* how to grow the native plantain or owl's clover the larvae need to eat at landscape scale. Yet much of Stanford's land endowment was legally required to be set aside for horticultural study!!! Here, it went extinct. Now Dr. Ehrlich is working to "protect" the few places where this bug can still be found, effectively advocating the same things he didn't do here on other people's property. In a landscape infested with exotics, "preservation" is deadly to native biodiversity. Are they "learning" how to fix anything by doing nothing?

This is one of our native grasslands here at the *Wildergarten*, 2 days later. Here, sandy soils were stripped with bulldozers. Here, key trace minerals are virtually nonexistent. Here, the budget came out of a nurse's paycheck with two kids in college (one at Stanford). Yet our native grasses are still green. The weather here is hotter too (Jasper is in a marine climate near San Francisco Bay). Nor did we get more rain in 2014. Here, owl's clover is making a comeback all on its lonesome. We have lots of checkerspots ("oh but not BAY checkerspots"). Do the Stanford academics at Jasper know about this? Some do, but that doesn't mean they'll admit it.

Exechia spinuligera
Source is Wikipedia commons

With regard to insects, the situation is relatively unknown and for two reasons. First, serious insect collections in California only began around 1900. Early 20th Century collections (including some from Glenwood) are dispersed among several museums, but there is work to unify their databases. Hence, there is yet no historic baseline for comparison.

Second, insect taxonomy is far less settled than is botany, even for fungi. Even with those bugs that have been described, we don't yet know how many bugs currently defined as separate species may in fact reproduce viable hybrids. We know little about what they eat (a particular peeve of mine) or what threats they face besides birds, other insects, agriculture, and development. We know even less about subterranean larval insect habitats. Hence, there is no technical basis for a historic comparison.

Yet it is inarguable that as native plants have declined and development has depleted open valleys (where the water is for plants), insects have declined as well. Interestingly, beyond the obvious, the causes of insect decline are largely a matter of speculation, in part because the causes may be so many. Besides pesticides, exotic plants, and mechanized chemical/GMO agriculture, there is even the possibility that toxins both directly from weed roots and indirectly from root exudates might inhibit terrestrial larval development as transported by fungal hyphae simply because of the mass weed roots constitute in infested landscape soils.

We have facilitated collections here for a survey of mycetophilid flies (left) whose larvae feed on mushrooms exclusively. The survey indicated good diversity, despite that it was started late and not a good year for fungi.

April 2016 – *Deschampsia cespitosa* in lotuses, verbena, clovers, and needle grasses

OK, so here is another part of the purpose of this chapter**:** Because the Spanish road brought exotic weeds here so early, our area was in an advanced case of decline. The true issue is the same everywhere**:** If PEOPLE don't get to restoring biodiversity, we'll lose a LOT more species. The biggest environmental threats we now face are too many higher order plants (mainly trees), and exotic infestation.

April 2014 – Black oak in the cage *(Q. kellogii)*.

Fixing it isn't easy. It means killing LOTS of trees, for years. And then comes the weeding.

That takes PEOPLE doing very expensive, complex, and exhausting but very satisfying work.

September 2008 – “Sustainable Development,” Communications Hill, San Jose, California
Biologically, the case of this slope is no worse than our property was.
In some ways it may be easier to fix because it is mostly surrounded with concrete.

Once succession has been halted and reversed, fixing grasslands is even harder. It means killing MILLIONS of weeds for years.

That takes PEOPLE doing very frustrating, expensive, complex, and exhausting but very satisfying work.

That’s the rest of the point. Fix it or it dies. Your choice. An opportunity is probably not far from your doorstep.

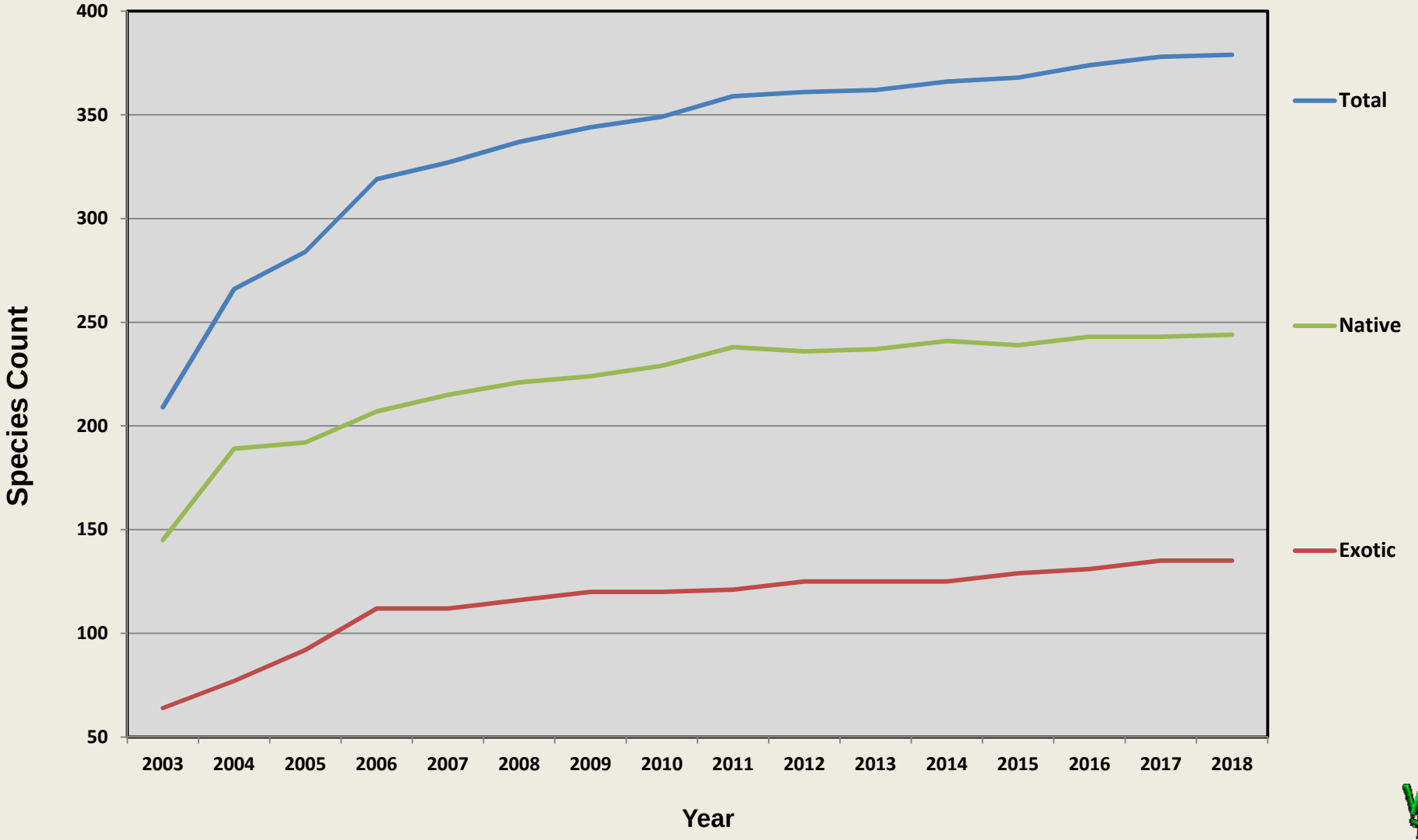
Pulling It Back from the Brink Of Extinctions

June 2019

This project started with the obvious. The initial goal was to restore a healthy forest and get control of French broom. Those goals alone were challenging enough while working 60-hour weeks as an engineer, at times 25% of it outside the country, and carpooling with two babies in daycare. By itself, broom took 10 years. Forestry is expensive and time-consuming work. Very few landowners or even public agencies accomplish even that much. Yet even now, in places here, broom is one of the few plants to germinate after 30 years!

June 2010 – Both photos are of smooth cat's ear just up the road, taken days apart, each head makes about 50 seeds

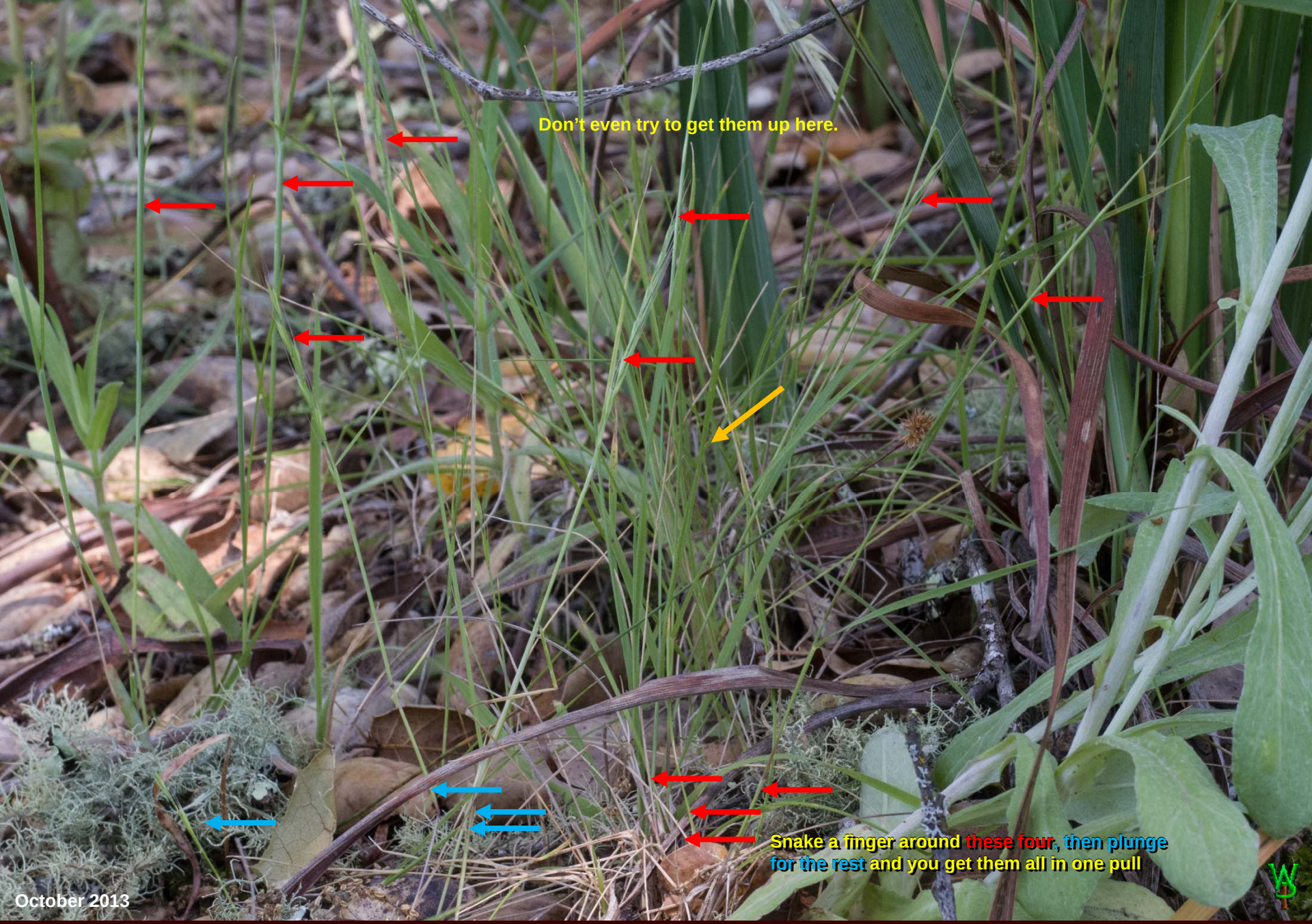
It was the successive waves of weeds after broom subsided, both those from the seed bank and those that blew in (above), that taught me how serious these real environmental issues really are. Yet these early problems involved only a few species. I knew there had to be many more, but at the time, I didn't know fully what was native or not. It was obvious that my own ignorance was the first thing to fix.



In 2001, thus began a process to learn to identify what was here. That alone took about two years of photographing, cataloguing, and studying the features of so many plants as they first expressed to get a handle on what was 200 species by 2003, (source data for chart). There is one other important feature related to this graph that goes directly against popular beliefs about herbicides. Note the rapid increase in the number of plant species from 2003-2006. That is when I was nuking large parts of the property with glyphosate and was still killing mass numbers of broom seedlings with triclopyr. One reason exotics are dominant is that they germinate early. Kill the sprouting seed in fall and late winter, and the natives still have time to come up the next spring.

Identifying juvenile grasses can be difficult, particularly within a single genus such as Bromus. Many of the exotics here (particularly small seeded rattlesnake grass *(Briza minor)*) take a few quite different forms just on our place. Relatively few professional botanists know their grasses at all, much less by their vegetative attributes. That latter learning process alone took 3-4 years, but errors lasted rather longer after a purchase of Brome grass that produced seed that looked very much the natives I'd paid for, but were in fact exotic.

But when it came to identification there was a more systematic problem. Most botanists identify plants by their reproductive features. This is WAY too late for control purposes when the plants can drop seed only days after heading out. Using fruiting structure can also be deceiving in the field (above). Many of the exotics here (particularly small seeded rattlesnake grass *(Briza minor)*) take quite different forms just on our place. Some of the keys used here are not used in botany books for identification purposes at all! Most of the keys I use detect a grass species by color, texture, or its growth habit at the ground surface, which then eliminates wasted time tracing it back from the fruiting structure to the ground for removal.



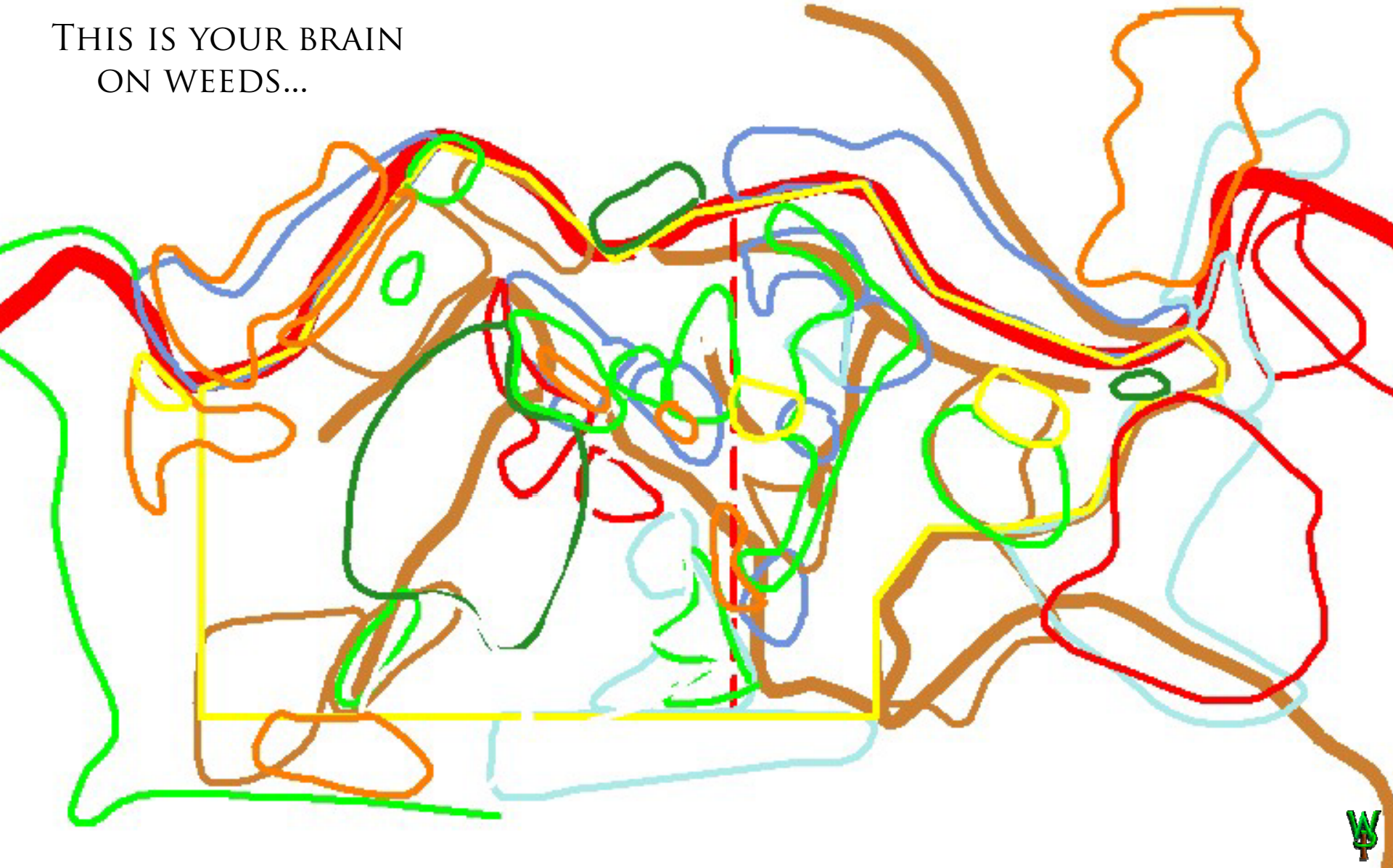
It’s hard enough to distinguish **“rat tail** fescue**”** *(F. myuros*) in needle grass *(Stipa lepida**)*** but weedy grasses can “hide” within native bunch grasses. So this image represents an easy one. Learning how to remove them quickly is yet another matter.

The goal became to purge the weed bank and build the native seed bank. Once one removes tree cover, the weeds came up in "layers" with the more dominant suppressing those that still lay dormant. Only a decade later did I learn that nobody had ever done that before. Yes, mulching and such do suppress germination, but mulch suppresses everything (somewhat). When your goal is to grow annuals, suppressing everything merely delays the recovery because the weeds will start to germinate as soon as the mulch rots down. Then there is the matter of supply, of weed free mulch. Two commercial chipper truckloads were not enough just for this hilltop (above).

Here, *Briza maxima* was treated with glyphosate, the last within the control boundary on a neighbor's property. This visit was a to check for any that were missed. There was one (1) left alive at the lower right, with viable seed hanging on it. It got bagged just after taking this picture.

Killing millions of weeds for years is what one gets to do, whether by mowing, tilling, chemicals, or winter burning. I may have since found how to do this faster but it starts this way nevertheless. To win, nothing exotic may breed. **Nothing.** What did that look like? It looked like everything was dead. It was terrible. My friends thought I was nuts… (I heard that). As one weed species was depleted, then it was the next, and the next, and the next… like peeling layers of an onion, sometimes two or three "layers" in a year. For years.

This is your brain on weeds...



Yet **none** of the broadcast techniques eliminate the need for hand weeding. It is a matter of simple arithmetic**:** No broadcast chemical or mechanical treatment is 100% effective. Kill only 99% of the weeds and most of the weeds make more than 100 seeds. The goal **must** be zero, a complete intolerance for tolerance. Yet one doesn't want to damage returning natives. With the scale of the problem we had here, one cannot begin to meet such a lofty goal even with fine-resolution tools for delivering fire and herbicides. The solution was "fragmentation" carving up the property into over 100 sites (above), each with different attributes, for management by sub-area.

Once the weeds thin and natives return, then the hard part begins. It's one thing to do everything by hand in a suburban back yard, but at landscape scale, take that long and you just get run over by the numbers. Protecting the natives individually, while dealing with an increasingly complex array of about 100 virulent weed species individually over a large area, renders control by manual weeding alone impossible. I can do about 80% of this with herbicides very rapidly and with minimal damage to non-target species. I hand weed the rest.

Eventually, the weeds do subside to the point that one can discontinue the chemical “antibiotic” treatments and rely almost entirely upon hand work. This means meticulous hand weeding over every inch of the property (plus a buffer) many times per year against multiple germinations, rapid maturation in warmer weather, differences in lighting, and visual fatigue when going that fast. Hand work over a property this rugged, this large, and under wildly variable conditions of weather, wind, and lighting with so many species (many demanding very different control techniques) is intellectually demanding, emotionally draining, and physically arduous. It goes on for long hours, seven days a week for months on end. Weed control typically starts in the late fall and, with rain in May, can go into July.

June 2010 – Italian thistle and slender oat, all of it, courtesy of The Land Trust of Santa Cruz County

Why would anybody do such a thing? Well, this is typical of the “open space” grasslands around here these days.

While I'm the only person in the world who gets to see this.

or this,

or this.

Despite the pain, the fatigue, and the sacrifices, the land pays you back.

It Doesn't End Here

March 2016 – This is the *Gilia achillefolia* that was found up the road, collected, and sown here, germinating at the edge of this burn pile.

When natives first come back, they are identified, photographed, and catalogued in the species list. Then they are monitored to see what they'll do. Sometimes they get protected until there are enough of them dispersed over a wide enough area to survive grazing pressure (above) and to make more seed. They don't necessarily first show up where they actually may prefer to grow. Some took successive experiments and therefore many years to establish significant colonies. Some actually showed adaptive changes in form as they colonized the property, a process since documented in a dedicated chapter. Others spread so rapidly they became pests.

June 2015 – Sanicle seed produces annoying burs, but the scent of the flowers is just amazing. But for the USDA, it might be a marketable spice.

It should be obvious that if so many native plants were not reproducing here for over a century, their associated insects could also be long gone. Some of those bugs might function as bio-controls, as even native plants can sometimes become troublesome, particularly without frequent broadcast burning. *Sanicula crassicaulis* in particular, is a pest here. It may be that a moth, *(Greya reticulata)* once kept them in check. With so few native plants around elsewhere, where and how would one find enough larvae to start a new colony without predation by birds or other bugs cutting it short? Can I import them? Think of how odd that request sounded to an entomologist I called at the State Department of Food and Agriculture! Does the State have a protocol or program for the reintroduction of native bugs? No. It turns out to be hard to do, sometimes on the same plant species.

Clarkia rubicunda are a good example of how long it can take to build up a substantial population of native annuals. This patch is by far the biggest we have despite that its incredible beauty earned it lots of extra focus. I found the source plants 3 miles up the road in 2004, collected a few pods, and seeded it here that fall in several places that resembled the conditions where I had found it to various degrees. Well, this spot worked, whether because the conditions are better here or they were eaten elsewhere I don't know. But then there was another nine years of weeding before I started to see a substantial colony culminating in what you see here, a total of 13 years since that first collection. Yet that first collection was in fact a second attempt.

On the other hand, these *Cammissonia micrantha* (Evening Primrose) are nice to see in situ, and are a preferred forage among deer, rabbits, and gophers being high in palatable protein. They became a technical curiosity, but also something of a pest. They seed profusely and happily occupy the cracks of our brick patio, then demanding the homeowner take unpleasant control measures.

May 2018

The interesting thing about *Cammissonia* AND *Clarkia*, is the mixed feelings I get when a biocontrol species shows up that eats them both! Above is a larva of *Hyles lineata*, a “hummingbird moth” with a 2-3” wing span (inset), big enough to eat a LOT of my pretty flowers!!! What to do? Don’t know. There are enough Camissonias to feed lots of caterpillars, but so far they seem to prefer the Clarkia. What if I take a few caterpillars and put them on the Camissonia, with the idea that future larvae might develop a taste for it?

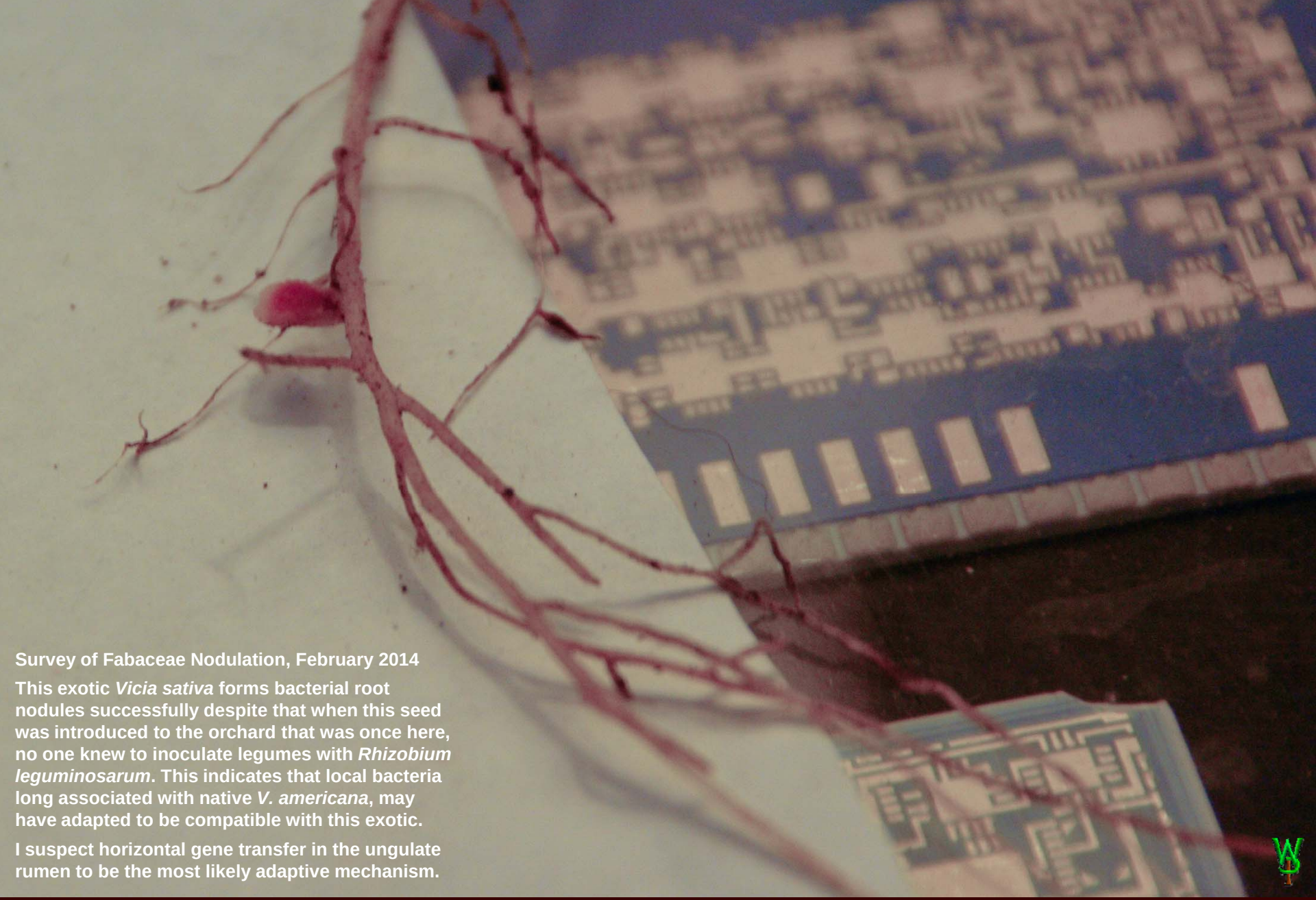
May 2015 – We have two genetically-identical varieties of this native clover here, yet one of them behaves as an invasive pest!

Plants and insects are often locally adapted on an impressively fine scale. I have learned through hard experience that even nominally native plants can either grow poorly or act like weeds. Hence, restoration of a full system is all about the local seed bank. Well, that was a problem here, as it had been so long since local natives had germinated, much of their seed was dead. How the native invaders re-entered and adapted and whether and how they got along makes a very interesting story.

January 2016 – *Amanita calyptraoides* (inset) showed up far from its usual northern limits. Why? It is amid by far the largest patch of California cottonrose *(Logfia filaginoides)* in this region. While it is an oak symbiote, it is at least 30 feet from the drip line. Might there be a relationship with the annuals? This sandy soil with almost nothing else growing here is almost chocolate with fungal fiber.

January 2016

Whether other bugs or fungi make it back nobody knows but there are a few signs. *Amanita calyptraoides* (inset) showed up far from its usual northern limits. Why? Perhaps because it is amid by far the largest patch of California cottonrose *(Logfia filaginoides)* in this region. While the fungus is an oak symbiote, it is at least 30 feet from the drip line. Might it have a relationship with the annuals? This sandy soil with almost nothing else growing here is almost chocolate with fungal fiber. As to systems, it takes years to build populations of breeding natives sufficient to experiment in other places to learn what they might prefer. Worse, we cannot burn as much as or when post-disturbance plants would probably prefer. Restoration? We're just trying to keep things alive and breeding while keeping the weeds out sufficiently that we can do experiments to learn how it works. In this spot, even native grasses are treated as weeds.



Survey of Fabaceae Nodulation, February 2014

This exotic *Vicia sativa* forms bacterial root nodules successfully despite that when this seed was introduced to the orchard that was once here, no one knew to inoculate legumes with *Rhizobium leguminosarum*. This indicates that local bacteria long associated with native *V. americana*, may have adapted to be compatible with this exotic.

I suspect horizontal gene transfer in the ungulate rumen to be the most likely adaptive mechanism.

Some soil bacteria that are symbiotic with native plants, may not have survived the onslaught of weeds and predation here. Observations on clover root nodulation found that some strains of *Rhizobium trifolii* were probably lost. Permanently? I think bacteria are a more adaptive system than we realize (above). This is discussed in the chapter on native plant colonization behavior.

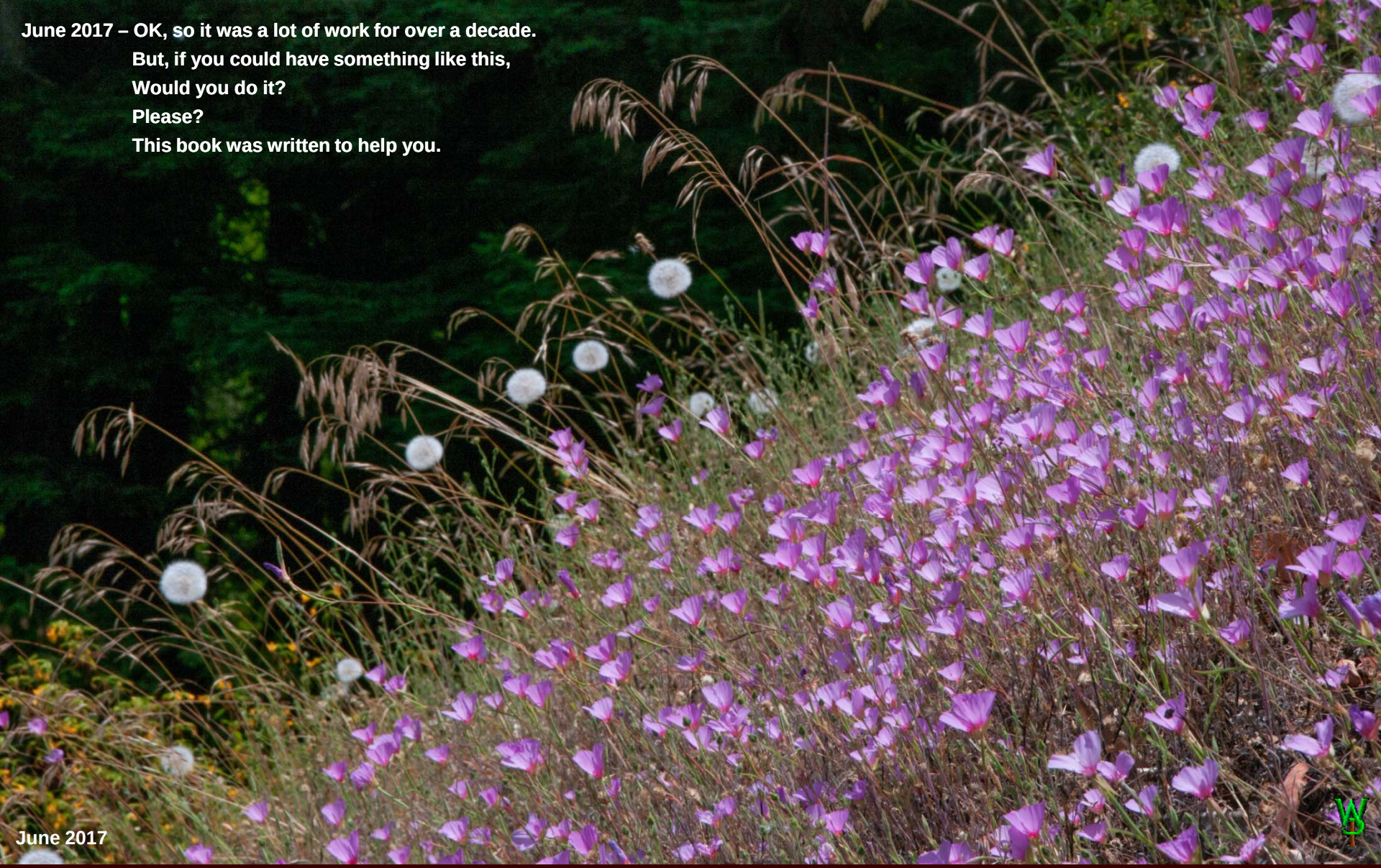
Just because a plant is still here and apparently reproducing seed, doesn't mean it's OK. These are mule's ears *(Wyethia helenioides),* the only ones in the neighborhood (not on our property). This plant usually spreads by rhizomes, but hasn't spread here in 15 years. It looks like it makes lots of seed, so I tried to propagate it and failed. Of the seed I sampled the second time, none were fertile (empty achenes). Why? Some plants require others for fertilization. Some require particular pollinators. Soil infertility too can induce empty seeds. This plant follows fire. I suspect that weed competition is a factor here, but there is one other consideration**:** As discussed in the site history, plants were managed for millennia NOT to be aggressive to other plants people needed. Fertilize it? Douse it with smoke water? It's an awfully small colony with which to be trying things, but what happens if I don't? This is where we are.

June 2017 – We have had California Tea *(Rupertia physioides)* show up elsewhere, but never in density like this, and this spot adjoins the Sayante tribal trail.

In some places (as above), we are seeing patches of plants along the old Indian trail. These, while very difficult to germinate, likely came from seed. So seed viability may extend longer than is commonly accepted, but this plant is prominent on only one other spot on the property, meaning that it might have been cultivated. Making these “determinations” of whether there is viable seed or not involves a degree of guesswork, and the willingness if not the desire to be wrong. With a place capable of sustaining natives without exotic interference, the general mobility of seed does have individuals showing up upon occasion after which they do colonize the place, albeit slowly and often needing help. How does anybody find out how all this works without making and observing various combinations while controlling exotics? It isn’t easy.

January 2017 – This surface curves over the base of the oak stump at the top. The left side gets morning winter sun, the right side not. The weed bank on the left has long been cleansed, so it is all native annuals (mostly *Stachys rigida*). In fall 2106, we had a lot of rain early in October. Surprise! The early water and fall sun angle brought up mouse-eared chickweed (*Cerastium glomeratum*) in that usually shady spot from the yet-to be purged weed bank. Two years later, it was rip gut brome on the right *(B. diandrus). C'est la guerre.*

One cannot simply "put things back" and expect it to work with weed seed present; the weeds are too dominant. So, what I get to do is kill things, every year. The first weed to come up was French broom, gobs of it. After that, rip gut brome, after that… It was like peeling an onion. Even now, every time we get a year with unusual weather, I can expect the unexpected in various spots (above). Every time I take down a tree, I get to start over in that spot. Cleansing the seed bank is the major focus of this project, unique in the world. Most "restoration" projects start in places with good prospects. Ours was a disaster, one reason I learned so much playing with it.



In some respects our results suggest there is good news. Of the estimated 175 native species that were not reproducing here for at least that 50 years, 150 are breeding now, despite the soil being so depleted of viable seed. Our state of decline was an advanced case because of the Spanish road. The fact that we have been able to recover so many plant species suggests that there is still time to save most of what is left of native biodiversity elsewhere. But, the number of species that have not returned here and the time it takes to get through the weed bank suggest that the situation elsewhere must be addressed both actively and soon. What the situation might be for bugs, nobody knows; some insect eggs can survive for several years. Fungal spores can last decades.

***Galium parisiense* – Wall bedstraw is one of the most annoying and destructive weeds we have left here, but there's less of it every year.**

The point of this little data dump and diatribe was not some esoteric stressing about a single obscure "endangered species" but the unconscious loss of the foundation of the entire successional system as repeated across the whole continent. Everywhere I go I see the same problems**:** economic abandonment and "environmental protection" (effectively "mandated neglect") allow botanical succession and growing weed infestations slowly to abet mass extinctions of locally adapted annuals. Once the plants are gone, how much longer the associated biota will last is anybody's guess. Experiments here indicate that while there is cause for concern, there may be time at least partially to fix it.

Who is going to do that? Have you ever heard anyone even talking about doing it? Heck no, most people *want* "environmental protection," what is in reality a huge racket that raises profit margins for the corporate sponsors of the policy. To its dependents in government and academia, it means jobs, but only as long as there are problems to justify them! To resource landowners, businesses, and their employees, it has been a disaster. Having researched this mess for 23 years, with activists, bureaucrats, academics, contractors, and lawyers doing the witless bidding of plutocrats seeking tax-free income, what almost no one seems to realize is that preventing mercantilist tyranny is why the Constitution specified limited government. Most people driving this are not intrinsically bad, but they are deluded by ideology, implementing their preferences through governments by slowly diluting constitutional protections for private property. Without private property, I would never have been allowed to deviate from that preservationist agenda.

People built the original ecosystems we all want to save. People are not an inherent problem. Yet this is not about single "right answers," simply because both land and the demands people put on it are so varied. Nor do we know enough about native ecosystems to be making blanket prescriptions. Instead, we must enact systems to *learn* how to fix this mess using the tools of greatness**:** experiments, tests, publications, patents, and insured contracts with real financial responsibility to manage competing risks among many unknowns. It really is best to start small, because so little is actually known about how to restore early successional plant systems at large scale. It can be frustrating, painful, and expensive, but it is immensely rewarding work.

My hope is that this chapter has informed you of the real challenges we face, their terribly misunderstood causes, and what you can do to help fix it. "Nature takes care of itself" simply does not work economically for people, nor for native habitat, nor for wildlife. You'll see what we did and why. My hope is to inspire you to discover more about how things work in your own back yard, no matter how small. ***I am not asking everyone to do things the way we did.*** Every situation is unique, people's values and capabilities are different, and over time, we all do learn. That is the beauty of responsible liberty, because by trying different things and sharing what happens we all learn how to do the best we can, to free ourselves from this mass-psychosis. Learning how things really work really is in our hands.

Sources and Methods

If you read this far and are familiar with the policies and procedures of government "environmental protection," then you know that the case this chapter lays out implies conditions with some very serious legal implications insofar as the Endangered Species Act is concerned. This page discusses the resources and subsequent methods used to derive what was the historical extent of the botanical biodiversity of our property and its immediate surroundings of like character (within a mile or two depending upon slope, solar aspect, elevation, etc). In other words, I used the following sources and methods to determine what is known to have once been here.

The Flora of the Santa Cruz Mountains by John Hunter Thomas was a 1961 publication of his Stanford University master's thesis. It was a compilation of herbarium records from numerous locations, botanical submissions from local experts, and personal observations covering the entire range from just south of San Francisco south to the Pajaro River. In his descriptions of each species, Thomas would note where samples had been found. I went through the whole book looking for every observation associated with "Glenwood" that I had not found here. Glenwood was once a well known resort town within a half mile of our property with a train station and 3 hotels suitable for academic botanists. They did an immense amount of work here.

I added each one of those "Glenwood" records to our species list under a category entitled, "Listed in Glenwood, but not found here." Then I culled those that *could not* be found on our property because they were, for example, specifically riparian (we have no perennial streams on our property).

I then crossed my list with the University of California Jepson Herbarium web site to see if said species from our list would be mapped as being somewhere near our area as a cross check of Mr. Thomas' findings. As species' names change over time, I also corrected the species names against the Jepson concordance.

Then I consulted the database at CalFlora.org, which has botanists' records of all plants found in California. If there is a record within a particular county, there is a link to a page for the compiled records of that species in that county. Each county page has a list of observations with dates, location, and the reporter's name, along with maps pointing to the exact location where the sample was acquired (if publicly known). I then went through my list of 'species not found here' and cross checked each one for when that species had last been observed in Glenwood, Scotts Valley, or our ridge.

Finally, I hired Randal Morgan, the best local field botanist of whom I am aware (RIP, and how I miss you Randy) to see what he thought of the likelihood of those "should be" plants being on our place. This added some candidates to the list and removed others. Yet there were already some species here which Randy had said was impossible, whose viability here had been or would soon be established by experiment. In essence, what I am saying is that there is a serious possibility that MANY species not on our list had already disappeared long before botanists got here to survey the area in the late 19th Century, 100 years after the Spanish burn ban.

In other words, things are probably worse than the case made in this chapter. I really don't know how to make it any more legit or plainer than that.

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

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