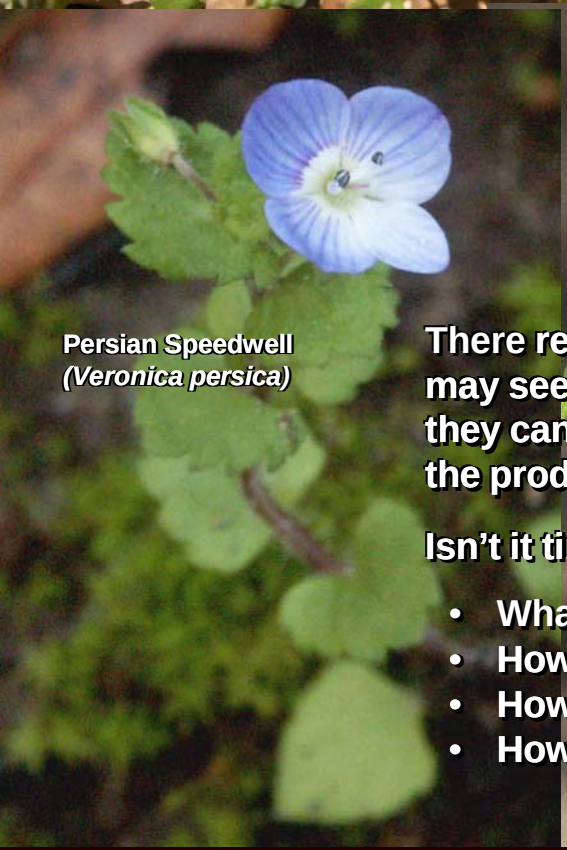
War, Famine, Disease, and Pestilence… Beating Back the Beast

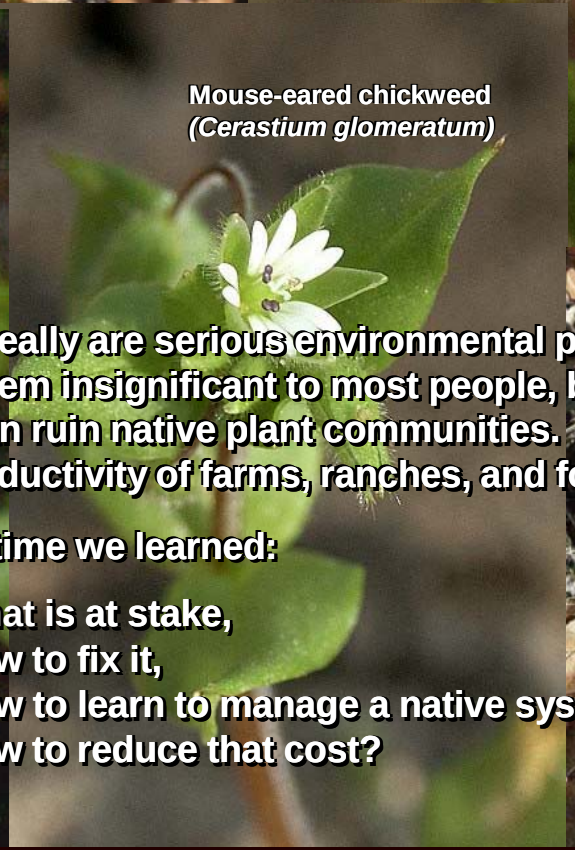
Four Leaved Allseed
(Polycarpon tetraphyllum)

Common Groundsel
(Senecio vulgaris)

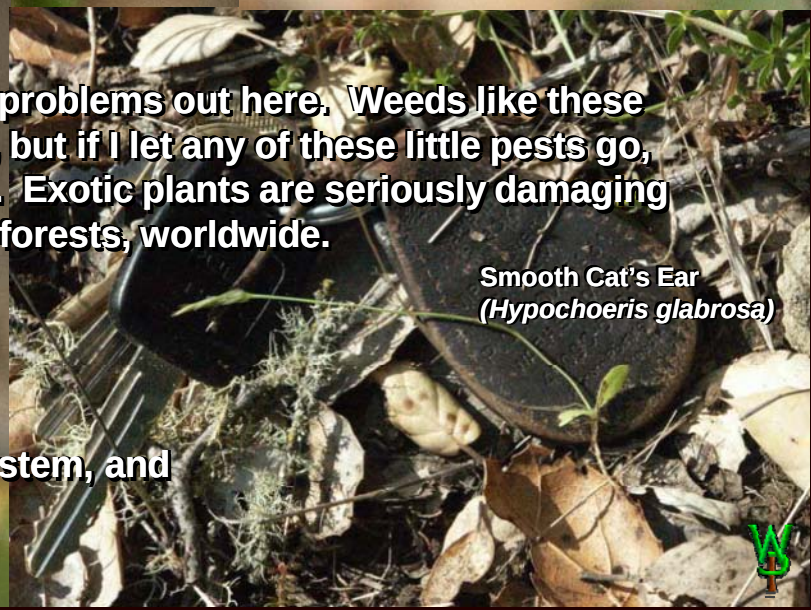
Catchfly *(Silene gallica)*



Persian Speedwell
(Veronica persica)



Mouse-eared chickweed
(Cerastium glomeratum)



Smooth Cat's Ear
(Hypochoeris glabrosa)

There really are serious environmental problems out here. Weeds like these may seem insignificant to most people, but if I let any of these little pests go, they can ruin native plant communities. Exotic plants are seriously damaging the productivity of farms, ranches, and forests, worldwide.

Isn't it time we learned:

- What is at stake,
- How to fix it,
- How to learn to manage a native system, and
- How to reduce that cost?

Grasslands Process Development Overview
An Explanation of the Graph

The top two lines of the graph depict the transition from single species management, when I ran around dealing with five or six individual disasters at once chasing them to their limits. I don't need to do that any more except within the perimeter of our control boundary buffer zones. That may yet change depending upon the choices made by my neighbors.

The "Mechanical" line was at first entirely bush whacking broom again with a perimeter residual. The rest of "mechanical" was hand weeding as that began to displace chemical control.

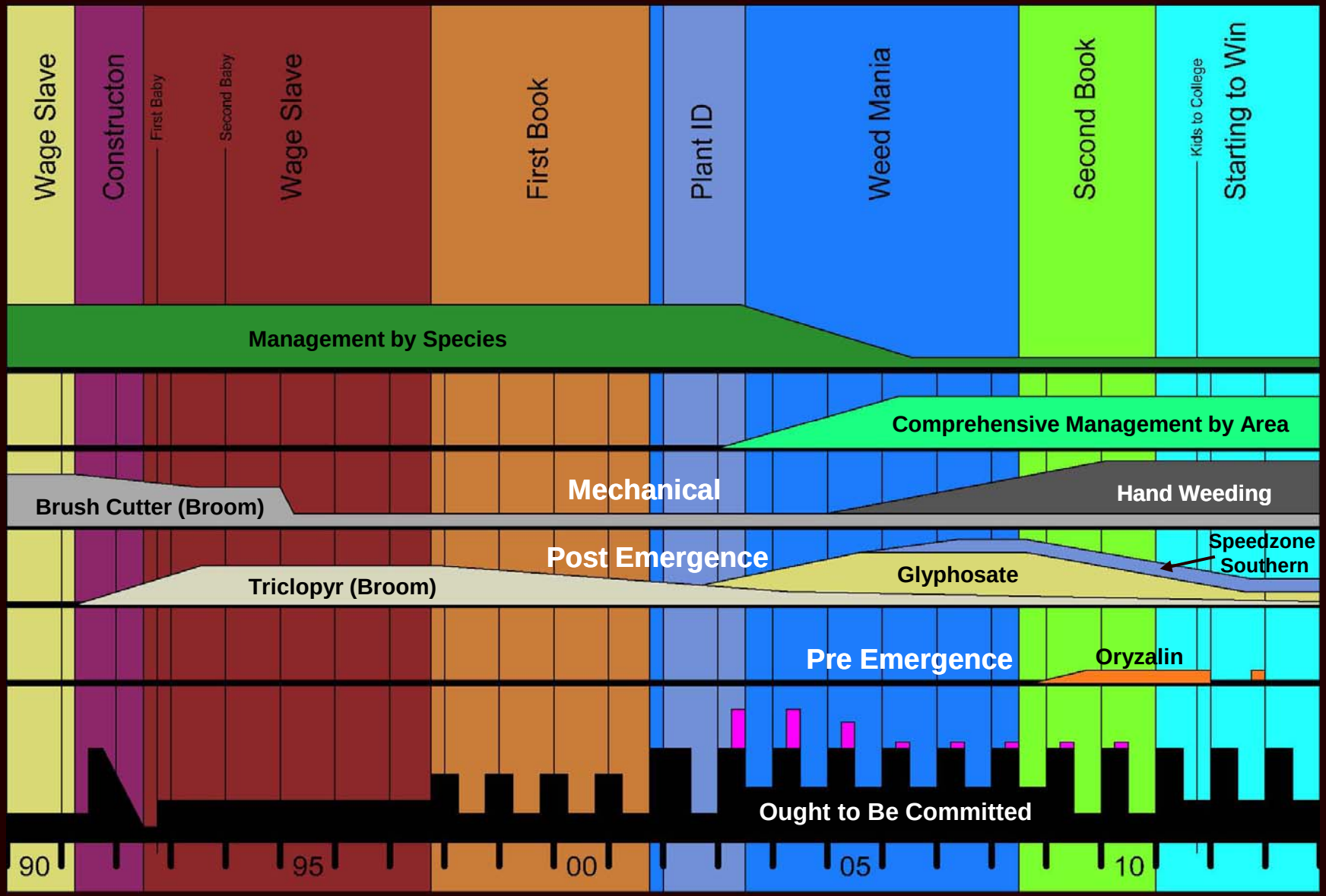
The height of each curve on the chemical lines DOES NOT indicate how much herbicide was used; it is more analogous to the emphasis, time, or area covered, usually only once or twice by broadcast spray and thereafter by spot spray. The Pre-Emergence line would be shorter in height but if it reflected actual area you wouldn't see it, so think of it as scaled by 5-10 times compared to the Post-Emergence line.

The tails at the right end of the Post-Emergence spray line represent two entirely different processes. The upper half, labeled "Speedzone Southern," represents continuing amounts used in the same areas for residual early germinating weeds such as chickweeds (both *Stellaria media* and *Cerastium glomeratum*). On most grasslands I use little to no herbicide at all beyond the chickweeds earlier in the year (January and February), a process of which I hope to see the end in a year or two.

I am continuing my experiments with pre-emergence herbicides and nitrogen out of scientific curiosity and caution against the day if the soils here become more fertile over time and germinate weeds in the seed bank I have not yet encountered in quantity. Fertility is a double edged sword. It supports more wildlife and or grazing animals yet it also germinates more weeds and undergoes succession more rapidly to chaparral and then forest. I am interested in more vitality, but I am not interested in generating needless work to do. As you might expect, I have had quite enough of crawling around pulling acres of weeds and don't enjoy spraying any more than anybody else does. I much prefer searching for that one isolated pioneer among a rich variety of other native plants of increasing complexity. Most of the 19 eradications we have attained so far are instances when I have controlled a new infestation before it could breed.

The glyphosate half of the Post Emergence chemical "tail" on the right represents the perimeter plus newly disturbed areas of two types. The first is when I take a stand of forest from Phases 1 or 2 to Phase 3, the usual response to which (besides broom) is herbaceous weeds such as hedge parsley *(T. arvensis),* catchfly *(Silene gallica)* or scarlet pimpernel *(Anagalis arvensis),* the latter of which is usually close to the bottom of the weed bank "onion." The second, although similar, is more distributed when I remove individual trees exposing spots that have never expressed their weed bank to light and warmth, then to lose their accumulated mulched leaf litter.

Grasslands Process Development Overview



So, to recap the vertical bars on the graph: I had built a house, got an engineering job in pits of the 1992 recession, plopped out two kids (OK, so my wife did the plopping), and I had made the company buckets of money (that they didn't share). In my "spare time," I had killed the broom, graded the roads, had culverts put in, removed the eucalyptus and acacia, made my first pass at thinning the forests within 200 hundred yards of my house, and written my first book. All within thirteen years. I thought I had done a good job. Then, I got **nailed**.

January 2003

By this.

I was busy, you know, working 60 hour weeks at an engineering job with international project responsibilities. My wife worked too as a nurse manager. We carpooled with two babies, both in daycare. I'd worked my tail off on thinning the forest and getting rid of broom. Then I quit my career to write a long and involved book about environmental policy, so I wasn't about to pay heed to something as pedestrian as a small dandelion…

This is no dandelion. This is a monster. This is cat's ear. We have two varieties. The first *(Hypochoeris glabrosa),* is a small annual. At first appearance, it doesn't seem like a huge problem to most people because virtually all the native meadows in this region are long gone, primarily due to exotic grasses and fire suppression. Other weeds keep it from dominating. It doesn't look like much, does it?

It is easy to miss.

This is the other form of this genus, *hairy* cat's ear, *(H. radicata)*. We had this one too (it is prominent in the image two slides ago). In fact, this was the first one I noticed, or rather, my wife bugged me about as I was finishing that book. It's hard *not* to miss; they were popping up all over with a fat rosette on the ground and big flowers.

This "dandelion" gets almost two feet tall and makes *lots* of heads. It is also a perennial, which gives it the potential to be the dandelion from hell.

I've counted as many as 70 heads in the making on one plant, each capable of producing about 50 seeds. That's 3,500 dandelion seeds, per plant, per year. There were five acres infested with at least a two-year head start. Big problem, right?

So, you are probably wondering why I regard the little guy on the previous slide as so much more of a serious threat. Well, left alone, it might be true that the bigger weed is more of a problem. Under management however, this one matures far more slowly. So I had plenty of time to stab each one with a sock tie-wrapped over a sponge on the end of a stick dipped in Roundup®, one-by-one. At the time, digging them out was so slow that they would breed faster than I could do it. I do it by hand now on the ones that blow in from my neighbors' properties every year. Compared to other weeds, this one is now relatively easy: big, slow, and easy to treat.

So, hairy cat's ear is both easier to detect and I have more time to find it before it blows all that seed. The serious problem with smooth cat's ear plants is getting rid of enough of them that you don't wind up right where you were.

They can be very hard to find, well, sometimes…

…until you suddenly realize that you have a lot of them. Over the four-year crush writing *Natural Process*, I wasn't even looking. Meanwhile, cat's ear was quietly colonizing our sand hill area from pioneer seed blown in from our neighbor's land. Up until then, my principal enemy had been broom, followed by rip-gut brome that went crazy on the nitrogen the broom had left behind. I had no idea of the magnitude of this problem. Nor did I understand how particularly vulnerable sand hills are to weed infestation.
When I first saw this from a distance, there were so many stems that I thought it was grass.

When the seed heads opened, the land looked like it had snowed. I estimate this infestation to be in its third year. By this time, it was too late for me to stop it from seeding. So what you now know is how much worse it was going to get. Having written a book claiming to have a better way to manage the environment, it wasn't as if I could let this go. It took me three years to control this disaster at great cost to our meadows. Note all the bare sand; there wasn't much diversity here.

This is what we had, and worse. Think what this means to ranching and meat production. It is hard to appreciate what this did to our property, but when I say cat's ear destroyed our meadows, I mean it.

But did we really have to spray it with Roundup? That stuff kills everything! The surfactants ruin your ground!! NOOOO!!!!

I didn't want to kill my needle grass, so I tried 2,4-D because the chemical company said it would work. The smooth cat's ear on the right had been treated with 2,4-D. As you can see, it seeded anyway. The real keys to getting control of this little beast are proximity, persistence, and Roundup® (no, I didn't like killing my native needle grass). Then it was demanding accuracy spot-spraying . ***Then*** it was hand-weeding.

Places with more sun develop the weed more quickly. Steeper ground facing neighbors acquires more seed Think about finding them all, hidden in clumps of other plants over 5 acres. So, why bother? **PEOPLE either take action to control weeds or there won't be any native habitat left, anywhere.** Otherwise, we should just admit that what the land becomes is of no concern to us, at all. That is your eventual and inevitable choice.

Smooth cat's ear often starts underneath other plants, which means that your first notice is the flower-bearing stalk. The yellow bloom is only about 2-4mm and only opens in the warmer parts of the day. The specimen at right has about 15 heads, each supporting 15-25 seeds. Published germination rates are above 90%. In sunny spots, I have two weeks to find them all from the time the shoot first appears to when they blow seed. So, if you are 95% efficient in killing them, that means you are losing. If you try for better efficiency, that means you slow down, a lot. If you fail to cover it all, the seed blows over your head and you lose anyway. So, if the best one can do in a weeding session for cat's ear is 95%, one needs to weed 5 acres thee times in two weeks, **about every 4-5 days** in order to win. One has to know where they are likely to be from the prior year, how mature, how many there are at any one time and place, how much sun has been on each spot, *and* the weather forecast in order to cover enough ground fast enough to win. If you want any "Natural" left, that is what it takes.

This patch was 3-4 years in the making. It is almost entirely cat's ear. Let us assume (charitably) there are an average of 10-15 plants per square foot. It is too steep and erosive here to till. So, if one is going to hand weed, let's say one can find, move to, remove, and bag ten plants per minute on average over an eight-hour day, which works out to **nine days per acre**. You have five acres to treat and (in May) two weeks to get them all. All winter and spring, as one removes them, more of them germinate. Some recover. Do the math. The only thing that worked was Roundup.® Now that the patent has expired…

This is what a weed monoculture can do, and it is impressive. Oh, and did I tell you that cat's ear is toxic to grazers?

This key to winning is to extend the control area to ‘launching points’ from which the weed can breed in large numbers beyond which the landscape is inhospitable to it. So not only do I need to clear our property of cat’s ear, but also (if they do cooperate) places like this one on a neighbor’s property from which it can blow in. That means broadening our control area to within logical boundaries (if such exist). There is broom here too.

This is a vertical sandstone promontory just down the road generally upwind and at a higher elevation than most of our property. From **a** ridge like this, seed can disperse over our entire property. Cat’s ear is so tough it can root under moss on a rock just as easily as it can ruin a meadow. Anybody in for weeding the face of a cliff overhanging a road below a blind corner, by yourself? I do, but I don’t recommend it.

Once I had control, maintenance was a matter of vigilant spraying at the edges of the control area, plus policing our own property for cat’s ear manually while looking for other weeds. Were we done? Not hardly. There were two problems**:** other weed infestations and my own ignorance.

Single Species Management: Nuke It 'Til It Grows

Although this is a picture book, I don't have photographs of a landscape of plants dying from herbicide poisoning. The reason is pretty simple**:** It never occurred to me to photograph my spraying operations; I just wanted the bad stuff dead. There was so much of it that it took ALL of my available time to assure that the cat's ear and broom was ALL dead before they could breed. There were indeed problematic consequences to that degree of focus.

Other weeds were beginning to express themselves due to the extra light from forest thinning and the removal of broom: rip gut brome grass, hedge parsley, and catchweed bedstraw. They were spreading while I dealt with cat's ear. In later years, I ran around killing them too. So, why didn't I spray them at the same time as the cat's ear? Simple, I was an engineer, not a botanist. I did not know native from exotic.

I bought every book I could get to learn how to distinguish the natives. I consulted the few useful photographs that were on CalPhotos at that time. Even then, there were misidentifications that only slowly became clear. Once I had done my best with what I could piece together in the way of knowledge, I begged Dr. Grey Hayes of the Elkhorn Slough Coastal Training Program to spend an afternoon here filling in the gaps. In the succeeding years Grey was instrumental in facilitating early identification of weeds, especially once I had acquired a digital camera. By 2002, we had identified and I had documented 190 plant species, a number that has since nearly doubled. The problem is that identification alone is not enough.

Most botany books identify weeds by their fruiting bodies, flowers and seeds. That is TOO LATE to make management decisions about what to kill or keep. With the nearly now nearly 380 species we have, and with the need to identify weeds as juveniles (especially grasses), it effectively takes a VERY knowledgeable botanist to weed, a person with knowledge, endurance, dexterity, and great eyesight are (so much for cheap labor). Effectively, I spent a year photographing and cataloguing native plants and weeds but probably cost myself more than three years because of the delay during which the weeds were breeding while I did that ID work, which then required much more removal in subsequent years (principally bedstraw and hedge parsley in the forest understory). The delay did considerable damage to the native groundcovers I had at that time and for years thereafter. Even then, our efforts were not entirely chemical; as mentioned before, we pulled some 37 garbage bags of hedge parsley alone in one year but the consequences of the seed it dropped lasted far longer.

Do I regret killing virtually everything over big areas? Not a bit. In fact, I wish now I had been more aggressive then, as I would have used a lot less chemical herbicide and would have got past that phase of the project several years sooner. Nobody likes looking at a landscape denuded by herbicides. Yet if had I to do this again, I would have not only killed what was growing, but would have applied pre-emergence herbicides to kill sprouting seed and added nitrogen to stimulate weed germination and therefore seed death. The weeds try first, and while they do, the "slower" seed lies dormant, especially natives. There is quite apparently a chemical and physical hierarchy to weed germination, where more aggressive weeds suppress those that follow once the dominant are removed. I call it "The Onion." Once the onion is dead, the natives do come back, some by expressing dormant seed, but more by virtue of seed mobility.

May 2009

Here is same that rock wall 7 years later. Armed with my newfound knowledge I had made sure all the plants were native!

Was I done?

There is no such thing as “done” when it comes to caring for land. All I *had* done was isolate the constituents of a system. I had not in any way optimized a total system in a manner representative of what the Indians might have done, never mind learned what its potential might be. Worse, the continuing demands of weed control severely limits experiments I might do. Still, I now have choices: The wire lettuce *(Stephanomeria virgata)* is inedible, obnoxious (up to 6 feet in height), sends seed on the wind, and looks at first like a dandelion. So, I’ll let somebody else grow wire lettuce. The Cammissonias and silver puffs make more food for wildlife. So, for now, I’ll grow more of those until I learn what else might be done with it.

That is what the Indians did with this land. This return of native "crop plants" is a direct result of knowing the land intimately, but that does not mean we know how to grow them. NOBODY has done enough restoration work for long enough to truly understand how the various native systems were managed. There isn’t even an organized effort to collect the necessary base data to make weed management more predictable to facilitate getting there (such as how many seeds per propagating body, the term of possible dormancy, expected germination rates, degree-days to maturity…).

There isn’t any grant money in it.

As weird as it may sound (and frankly, it’s sad), I am told that we are farther along than anybody on the entire Central Coast of California and possibly all of North America, parks, conservancies, and “pristine areas” included. I wish it wasn’t that way, but apparently that’s just how it is. There is an enormous amount of scientific work that needs to be done just to understand how the living elements of our immediate surroundings get along. What better living laboratory could there be than a purely native plant habitat?

This is the same spot I had thought was grass in 2002, now all native cover. Why is it so sparse? Well, first of all, it is almost pure sand, so it is relatively infertile. Then there was removing layers of “the onion." The cat’s ear seed bank was gone within two years, but then there were rip gut, soft brome, red brome, rattlesnake grass, catchfly, horseweed, *Filago gallica,* wall bedstraw, and scarlet pimpernel (in that order). Each species in the “weed bank” suppresses others until it its depleted, much like peeling layers of an onion. Each requires its own process. Early on, our control efforts were by species, to deal with the speed at which they spread. As we gained control, we were able to manage by location, but that meant dealing with the maturation rates of many species on each spot.

This is the worst of what I see in cat's ear these days, representing what I call a "systematic error," a location I missed late in the year resulting in two heads, luckily still with some seed (white circles). Needless to say, there are other things I would rather do than weeding. So the desire to declare victory *some* time in the summer is great. This incurs the risk that something will make it after I've quit for the year. The immediate problem here is mouse-eared chickweed *(Cerastium glomeratum,* gold*)* with the whitish tube for a flower. Besides grabbing the cat's ear seed, the chickweed is an immediate problem as the seed inside that small, whitish tube is already viable (it is "pseudo-cleistogamous"). There is also a single Briza minor (red circle). Unfortunately, even though the weather is too cold for cat's ear to mature and blow seed, it demands attention now. The natives are small-flowered lotus *(L. micranthus)*, Spanish lotus *(L. purshianus)* and slender tarweed *(Madia gracilis)*. If I 'come back to it later,' the lotus will cover the cat's ear, leaving it both numerous enough to slow me down at a critical time, *and* hard to find when it is matures, which is when I have less time to find them all before they blow. Moreover, the ground is softer in March and the weed smaller, so it's easier to pull. So I have to keep the biology of each weed in mind and the treatment method for each while I plan my hand weeding. In this case, I must deal with them both now.

This is what “leave that for later” looks like in a grassland. One can still find the cat’s ear, but the chickweed is now very hard to find. There is now not much more time left before the cat’s ear will start to bolt and seed. At this point, that means one must weed more frequently in order to attain sufficient yield to reduce their numbers in succeeding years. This spot is particularly bad every year because of the pattern of air currents on the property. One must know all such places. I have found that breaks in slope tend to grab more seed, convex edges because of eddies and vertical inflections because the seed has mass and momentum. This represents only what came in last year. This is what “winning” looks like in the real world until I can get my neighbors to cooperate more fully. The yellow area on the lower left is a chemical burn from a 2-4,D treatment for chickweed from which the natives will recover.

When I first burned brush in this meadow, most of the bunch grass *(Nassella lepida)* died. Then the filaree and wall bedstraw went nuts. These grass plugs were planted in February 2007. They survived with almost no rain thereafter, from the end of February to October with over 40 100°+ days and most of the rest in the 90s in a soil with less than 2ppm nitrate. Yet they hardly seed and have not spread since then (2013). However, the lupine, purple cudweed, various clovers and three lotuses have increased in density considerably with deer weed *(lotus scoparius)* and monkey-flower trying to cut in. I'm not thrilled with the idea of a chaparral here. So I pull deer weed here, with the secondary goal of disturbance to germinate the weed seeds to remove them from the seed bank. This is a very sandy soil within 100' of my sand hill. If I burned this spot regularly as the Indians did, there might not be grass at all. There are a couple of Clarkias in the area too, which the aboriginal tribes also farmed. There may be no way to know if clarkia was dominant here as I am told Clarkia seeds are good for only three years. Seeds of the lily family seem to remain viable for a long time.

Wall bedstraw *(Galium parisiense)* along with red-stemmed filaree *(Erodium botrys)* played a key role in destroying one of my best meadows just after doing a burn pile in one early on. When the bedstraw mixes in with Lotus micranthus it just disappears, and can be all kinds of fun to find them all. Nor is this situation unique to Lotus.

In Golden Yarrow
Eriophyllum confertiflorum

In Small-Flowered Lotus
Lotus micranthus

In Deerweed
Lotus scoparius

Perhaps you have heard that “old wives’ tale” about how weeds can hide. This is wall bedstraw in three different types of plants. In this instance, I’ve pushed the contrast to help you see them. The bedstraw has a whorl of five leaflets around it (like the one in the inset), while the lotus has three leaflets. We have about five acres infested with it to varying degrees. We had to develop specific techniques to separate them efficiently when weeding that differ with the mechanical attributes of each host species. Remember at the beginning of this picture book that high visual acuity was a must? There is more to it than that, as you will see.

Here was a wad of tiny wall bedstraw seedlings *under* that deer-weed bush (the third one on the prior slide). Deer-weed gets about 5-6 feet across and about 2-1/2 feet tall. It's a tangled mess of wiry strands. Can you imagine weeding tiny bedstraw plants, one-by-one, out of a hundred or so shrubs like that, some full of ticks, and about a quarter of them with Lyme disease?

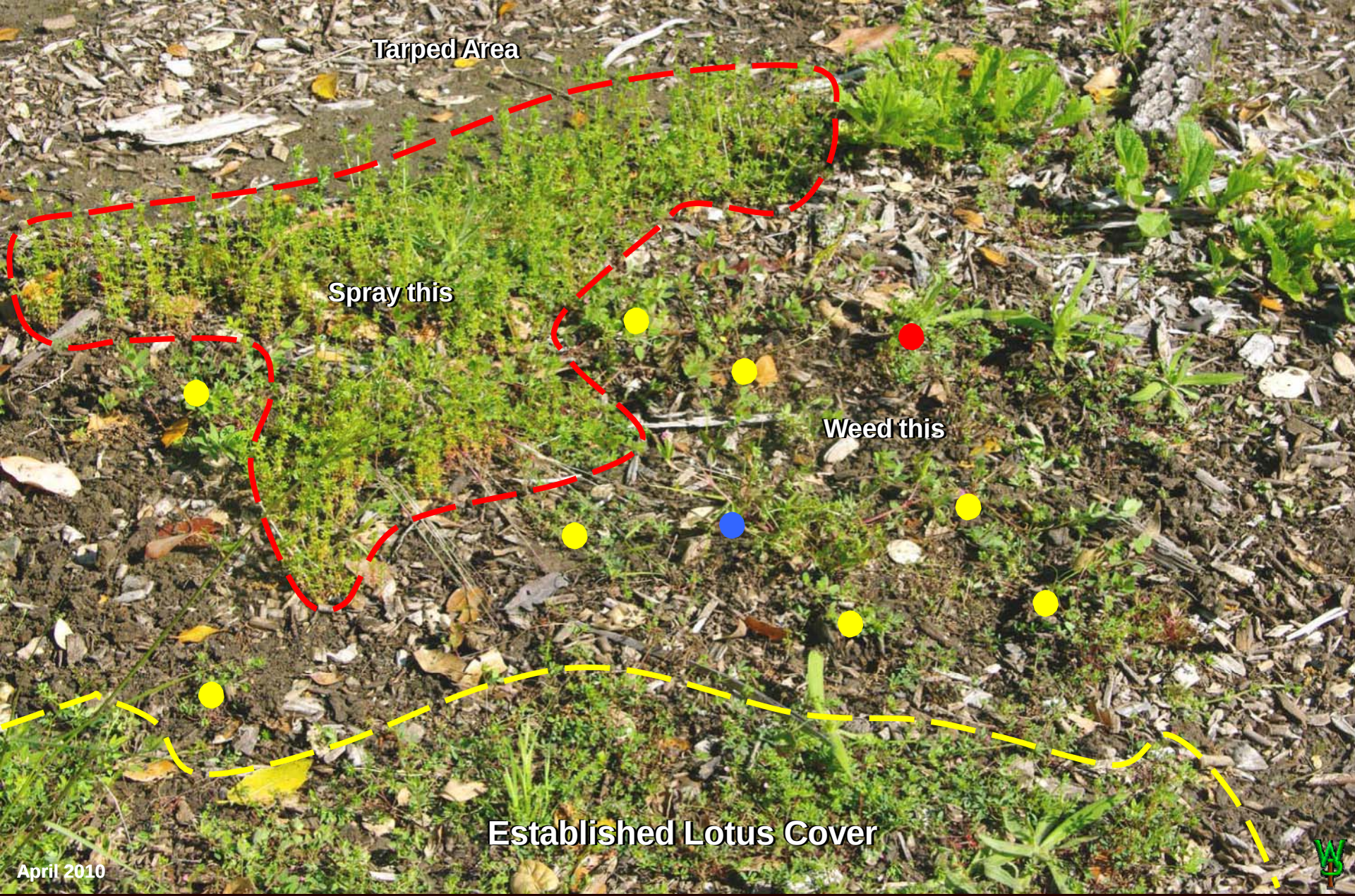
No? Frankly, neither can I. So, I pull the whole bush, frequently. The reason is that it is prolific. Deer-weed run amok would make such a mess of this place it is no wonder the Indians would just light it on fire. So, if that bothers you, consider, the bureaucratic approach to this pull-or-not-to-pull decision:

1. Call a professional botanist and get an appointment to assess the situation. Wait a week for a letter.
2. $500 (at least) later, send the botanist's written opinion to the bureaucrat for approval.
3. Meet with said local public official for a site inspection.
4. If all goes well, pay another $350 for a removal permit.
5. Wait two months for approval to remove the plant (they're really busy because of budget cutbacks).
6. Put up a $1,000 bond just in case something bad happens.
7. Meanwhile (of course), the weed has bred.
8. Get a final inspection to verify that there was no other harm to the environment.
9. Oh, and your bond money will be returned (eventually) without interest.

Now, if that seems far-fetched to you, just remember**: This is exactly how things work in many communities subject to the California Coastal Commission** if the plant in question is a tree. Now, before protesting about how different a case that is, please consider the results of what I did to care for my land, especially by thinning it. By the time this picture book is done and you witness the comparison, I think you will realize the absolute futility of managing such a complex problem the bureaucratic way. It is not only unaffordable, it cannot work.

We had a lot of rain in fall 2009, followed by a succession of warm rains the next spring. These combined events made the blast of wall bedstraw especially virulent, even after the area had been re-colonized by native *Stachys bullata* and *Madia gracilis*. The seedlings were evenly dispersed over large areas, indicating that this was an expression of the weed bank, as opposed to clustering around a spot where an animal may have bedded down for the evening or a plant was missed the prior year and bred successfully (what I call an “incidental error”). Here, the bedstraw stem is strong enough to pull the root, but the root is not too deep. Such optimal weeding conditions after rain deteriorate within hours (yet another reason why it is important that a land steward live on-site).

Remember that I said wall bedstraw can wreck a meadow? This is the same area, only **six days** later. The bedstraw has almost doubled in size. I promise you**:** the roots have grown just as much. These plants are now at the extreme limit of what one could weed by hand with effective yields in this hard packed soil. Elsewhere, in looser soil, this size is just right, a level of detailed site knowledge that is critical when it comes to planning where to be and when. Once it sets seed, one can tear the root and perhaps kill it, but one does not want so much left that getting it all takes too long. So, because we need to get a lot of it early and are at the size limit *here* and because we have many spots just like this one only vastly bigger in area, and with other weeds just as bad, do I spray or weed?



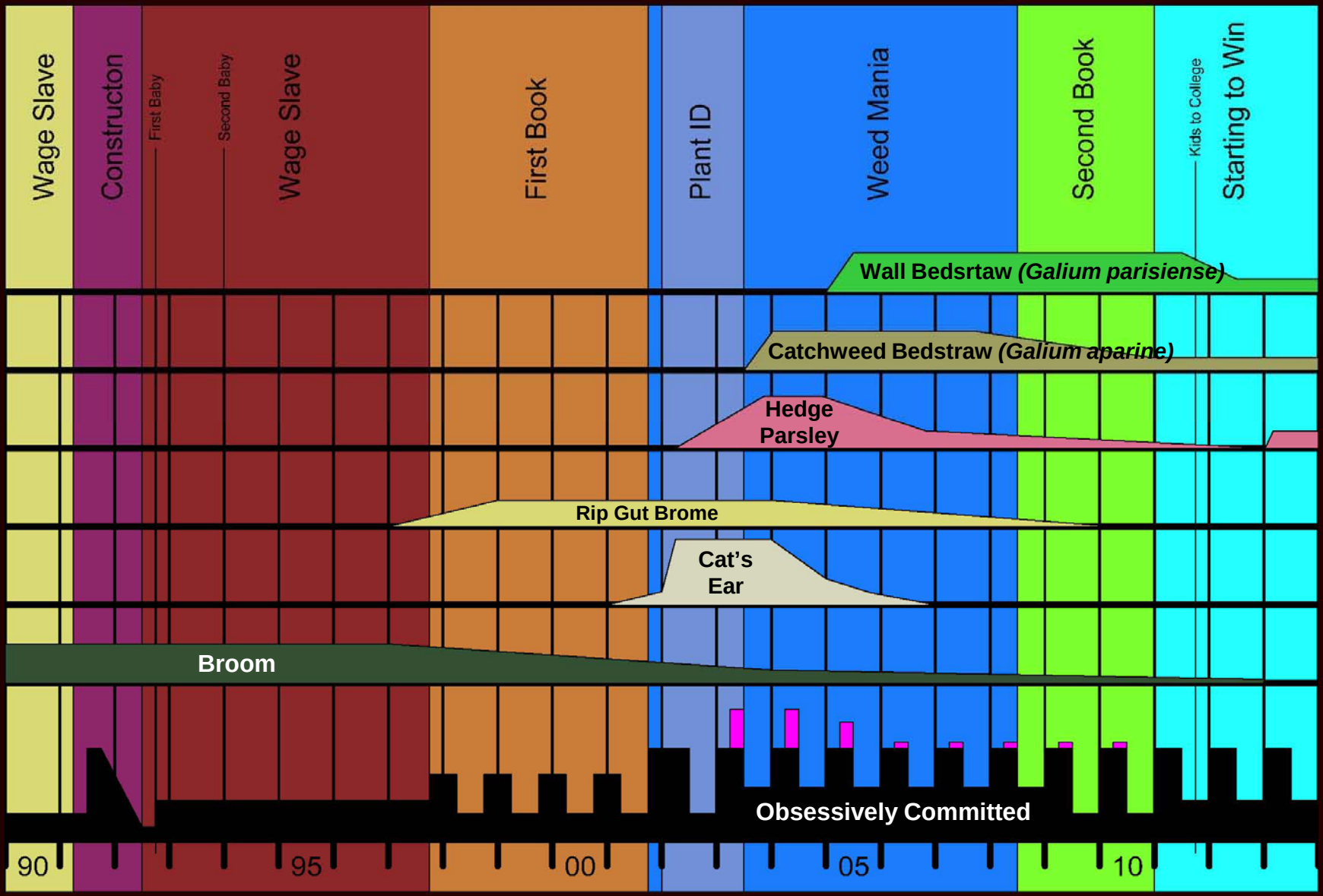
In this case, the answer was “both” because a black plastic tarp over a compost pile had precluded bedstraw germination across the top left of the photo. We did not yet have much native groundcover here, so I hand-weeded around the natives (the tree clover (blue) and lotuses (yellow)); then I spot-sprayed the area inside the red line. Next year, I expect a similar problem where the tarp had been. Note the difference between the area treated similarly last year (bottom) and the sparse lotuses in the "weed" area with the dots).

Once the bedstraw seed bank (prior slide) is mostly depleted, that spot will start to express other weeds. Only ten feet away from the last slide here we had a sparse weed bank "layer" of scarlet pimpernel *(Aganalis arvensis;* red), with two non-native clovers and some random grasses. Some, such as small-seeded rattlesnake grass (*Briza minor;* green) are imported annually, while others, such as this remnant of nit grass *(Gastridium ventricosum;* blue) are from the weed bank (note: I am only circling one example of each weed species present here). I need the few natives to breed. Pimpernel is easier to remove than bedstraw, but more toxic and harder to wet with herbicides. The pimpernel is often the last broadleaf weed layer in the onion, so now clovers and lotuses are doing their thing. Typically, the first clover is exotic hop clover *(T. dubium,* not in photo*)* or rose clover *(T. hirtum,* yellow thanks to you US government and Santa Cruz County). Then the natives slowly colonize the area from elsewhere. The pimpernel is a much slower developing species than the wall bedstraw, so it won't drop seed until June. So, do I weed or spray? If so, when? Weed, NOW. Why? The natives and weeds are closely mixed with two cat's ear plants starting to put up stems (white; just one in the photo). At that stage, it will blow seed in three weeks. The small seeded rattlesnake grass will drop seed almost as fast but the Gastridium won't seed until June. So, once I started, and with so many species calling for varying processes, I finished. If the spot had been larger or if I had more demand elsewhere, I'd have addressed the immediate needs here and come back later. It's all about speed. So, am I done?

To give you an idea of what weeding grasslands is like, consider this photo. This needle grass seedling, in the second meadow in this picture book**,** is infested with wall bedstraw (*G. parisiense* circled) from the "weed bank." Wall bedstraw is quite problematic**:** It is relatively inedible, difficult to kill with herbicides selectively, hides easily, and can seed when less than 1cm tall. They can grow up to two feet across. Each makes a huge amount of minute seed that can travel long distances as burs. The seed can remain viable in soil for 30 years. The root goes deep as it matures and breaks easily unless pulled at the right time. The roots will regenerate a plant with a weaker stem. At this density, wall bedstraw can produce about 50 seeds per plant (hundreds when they are big). If I don't get them ALL, they will grow to about six inches in height and take over this needle grass completely, producing a carpet nothing wants to eat (it is both coarse and mildly toxic). This area had been hand-weeded since 2005. I count 9 species here.

This is the way it looks when weeding once it is fully a grassland. Finding a few 6” tall bedstraw plants, or any of the other 110 weeds we manage in this half-acre is a challenge, but if you want a native meadow, this is what must be done until we have better processes (more on that later). It may *look* impossible to do by hand, but there are ways to take it from virtually impossible to merely painful. First, the grasses mature before the bedstraw does. I have developed visual vegetative keys to identify and remove the exotic grasses when they are small, long before they set seed. This means that I can ignore them unless they are “sore thumbs;” i.e., the few that I missed before. Similarly, I reduce the bedstraw to a few per yard long *before* the native annuals get big enough to make things difficult. By this time, the bedstraws are few and large enough to reduce the mayhem one inflicts while looking for that last one. As you will see, we have more powerful processes in the works that may make this type of effort far less arduous.

Single-Species Management Overview



Explanation of the Graph

This graph about single-species weed management is not terribly complicated. The height of the bars represents relative time expended. These weeds were such big problems that they all had to be brought under control before taking on anything else. It was simply a matter of mathematics of how many seeds were being produced per plant in any one year. Effectively, unless my control efforts were far better than 99%, there was not going to be progress.

The rapid decay rate of cat's ear is a testament to the effectiveness of that control effort coupled with high germination rates that make a long-lived cat's ear seed bank unlikely. The other weeds took longer, not because I wasn't getting them all, but for three other reasons.

First, their seed is more capable of extended dormancy in the soil, particularly French Broom (a legume) and hedge parsley. Cat's ear germinates so efficiently that it is seldom good for more than a couple of years.

Second, there were simply so many of them over such a huge area, that it took a long time. I estimate that there were at one time over three million broom seedlings on the property at any one time. At a rate of pulling one every five seconds (which is fast) six days a week for six months, one would control less than 10% of the crop. It's no way to win. I sprayed.

Third, most of this soil is so poor in nitrogen that it will not stimulate high germination rates.

These battles simply had to be won before I did anything else.

Finally, in the case of bedstraws, *G. parisiense* was in the seed bank and the amount was simply huge but other weeds were suppressing it. It is also more likely to wait to express "in a good year" (warm and wet), so its dormancy is apparently more extended than *G. aparine.* As to the latter, a full sized plant makes hundreds of seeds and I had let it go on the authority of published experts that it was native. In my opinion, that belief was false. In any event, because I had let it go, there was a lot of viable seed in the soil that has lasted 11 years so far. Most of it has germinated and was killed but when I initiate a disturbance, such as thinning trees in an area that it had infested but not germinated, I still get a big response.

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