


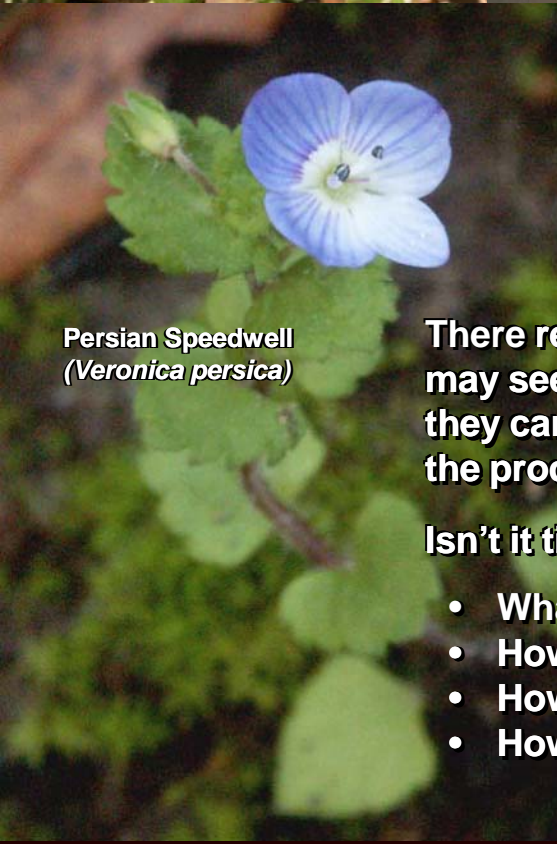
WAR, FAMINE, DISEASE, AND... WHAT?



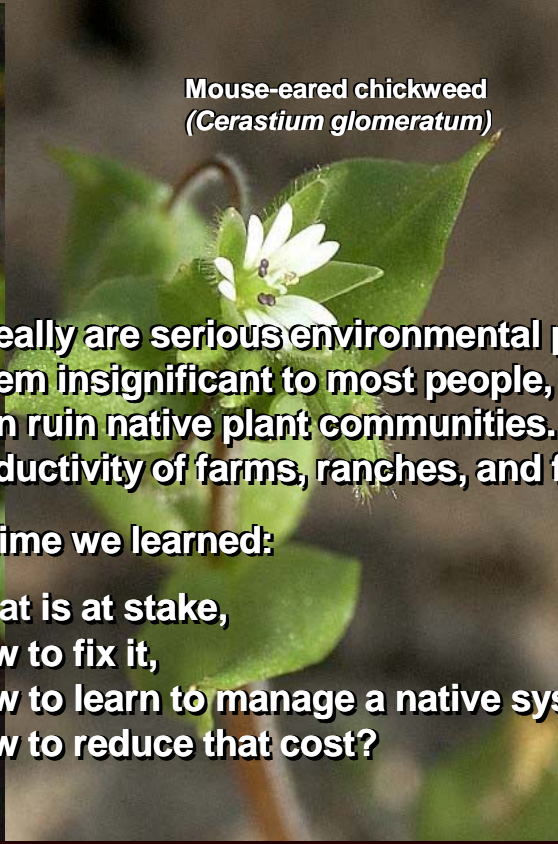
Four Leaved Allseed
(*Polycarpon tetraphyllum*)



Common Groundsel
(*Senecio vulgaris*)



Persian Speedwell
(*Veronica persica*)



Mouse-eared chickweed
(*Cerastium glomeratum*)



Catchfly (*Silene gallica*)


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?



Smooth Cat's Ear
(*Hypochoeris glabrosa*)

A photograph of a field with tall, dry grass and several small yellow flowers. A rusty wire runs horizontally across the lower third of the image. In the bottom right corner, there is a small green logo that looks like a stylized 'W' with a red dot.

Cat's ear, rat tail,
broom, Italian thistle,
and rip gut.

April 2004

So, to recap: 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.



By this.

I was busy, you know. I was working 60 hour weeks 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.



Hypochoeris glabrosa



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.

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 them with a sock wrapped over a sponge dipped in Roundup® on the end of a stick, 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.

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, sometimes...



April 2002

...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 this sand hill 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. When I first saw this from a distance, there were so many stems that at first I thought it was grass.



April 2002

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 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.



March 2003

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 have a 95% detection efficiency, 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 three 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.





May 2002

This patch, 3-4 years in the making, 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 herbicide manufacturer *said* we could kill it without killing grass with 2,4-D, but it didn't work; the leaves browned, curled up, and then it seeded anyway (from what I can tell, the claim was wishful thinking in pursuit of the golf course market). The only thing that worked was Roundup.® Now that **the patent has expired...**



W

March 2010

This is one year's worth of cat's ear these days, along with mouse-eared chickweed (*Cerastium glomeratum*). The natives are small-flowered lotus (*L. micranthus*), Spanish lotus (*L. purshianus*) and slender tarweed (*Madia gracilis*). The chickweed is an immediate problem as the seed is fertile inside that small, whitish tube (it is "pseudo-cleistogamous"). Unfortunately, even though the weather is too cold for cat's ear to mature and blow seed, it demands attention now. If I 'come back to it later,' the lotus will cover it, leaving it both numerous, harder to pull, *and* hard to find when it 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.

Not only do I need to clear our property of cat's ear, but also (if possible) places like this one from which it blew in. This key to winning is to extend the control area to as far as the weed can reach us in large numbers but beyond which the landscape is inhospitable to it. That means broadening our control area to within logical boundaries (if such exist).

This is a vertical sandstone promontory just down the road. 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.


At the beginning of this process, I did not know much more than most people re what was a weed and what was native. I had grown up in the Bay Area, so I was able to distinguish plants I did not recognize, but that knowledge did not take me very far. So, as soon as I had a handle on cat's ear, I spent a year allowing some weeds to spread while I reduced my ignorance, photographing everything so as to get it identified. At that time, the public information was confined to botany books and a few online pictures by dedicated volunteers.

Were our environmental academics able to focus upon learning and teaching how this system works (instead of being forced to chase grants to do research to justify "preserving" ever more land), that knowledge would have been readily available. As it was, the consequences of ignorance in making identifications cost me about three years of total hell seven months per year, in other words, about \$250,000 worth of arduous labor.



February 2003





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?





April 2009

This is the same spot I had thought was grass in 2002. 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 up came Chilean 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 its “account” runs down, 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.



April 2010

Same area in 2010 (a wet year). As the natives repopulated, the area increasingly became a complex mix of numerous species. In this spot, the more commonly represented native groundcovers are *Filago californica*, three clovers, miner's lettuce (2), two tarweeds, miniature lupine, two camissonias, stonecrop, fairy mist, lotuses (3), cottonweed, two species of *Navarettia*, *Sagina*, and not a few more, totaling about 26 native and 15 weed species. Interestingly, although it might appear that the increasing groundcover (especially clovers) over the prior year might be indication of an increasing native seed bank, the reality is more complex.



June 2010

Same spot two months later. If you noted that the pattern of shrubs in the prior photos keep changing, your observation skills are excellent! Why? This sand hill system requires occasional disturbance or it eventually goes back to chaparral and then forest. For now, I am keeping this a sand hill, because I don't want a forest here. So, I pull the bushes and burn them, constituting that disturbance. While doing so, I have noted hunks of amazing fibrous networks of mycorrhizae. Note also that the clover seems to have disappeared, leaving bare sand! Where did it go? I am guessing that ants took a lot of it and stored the seed. Now that the clovers are done, we're getting slender tarweed (*Madia gracilis*), and various Navarretias.



Early May 2010

This the same area a month before, closer to the surface. Go ahead and zoom the image to appreciate the complexity. This is an optimal time of day for weeding as the flat lighting enhances contrasts and edge effects with lower reflective glare. What it means is that I can distinguish individual grass blades, filago, or wall bedstraw rapidly and get them all. What it doesn't facilitate is getting the understory weeds. That takes overhead lighting, but removing a top layer of weeds also helps to see them.



April 2012

I hope you wondered what I means by “understory” when talking about low growing groundcovers. Well, here it is: Stonecrop, *Lotus micranthus*, *Trifolium gracilentum*, a *Cammissonia*, *Navarretia*, and mosses. We do “small” here. Four leaved allseed (*Polycarphon tetraphyllum*, a weed found here but not in this photo) grows as small as the mosses in this sand as do wall bedstraw seedlings.



March 2008

To give you an idea of what weeding here 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 then breaks easily when pulled. It regenerates. One must get them at the correct stage of development. At this density, wall bedstraw can produce about 100 seeds per plant (thousands 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’s coarse and mildly toxic). This area had been hand-weeded since 2005. I count 9 species here.



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 botanist and get an appointment to assess the situation.
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. Put up a \$1,000 bond just in case something bad happens.
6. Wait two months for approval to remove the plant (they're really busy because of budget cutbacks).
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.



April 2009

Now you understand more about what is meant by an image like this. It is printed in high resolution as well.





April 2009

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





View Toward
Prior Slide
Location

April 2009



April 2010



This is the ridgeline 75' above the base of the sand hill. On the left is 2009 and on the right is the same spot the next year. Although the bumper crop of lupine in the left slide bred successfully, their seedlings did not appear the next year. 2010 was not a good year for lupine in general, which seems to prefer a drier spring, but it was a GREAT year for clover (prior slide). However, you don't see the clover up here, except in a few denser patches near the back (red outline). This distribution, plus the fact that I stirred up this patch with a hoe five years prior, is strong indication that the clover seed bank on this ridge was exhausted. The dense clover patches in the red-outlined area are the scions of the colonizers up on top from recent years. **Santa Cruz Sand Hills** are demanding because they are wide open for weeds. Yet as it turned out, we had bigger challenges than weeding what was at the surface.



June 2011

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



April 2010

In general, the clovers tend to be more prevalent in wetter years.
Here it is growing amid poison oak and irises.





When I get a great clover year like 2010, that is the time to harvest. Because harvesting clover is such a messy and destructive business, I have no worry about depriving that spot of seed. This is simply a huge haul. I even gave some of it away.

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.

SINGLE-SPECIES MANAGEMENT OVERVIEW

