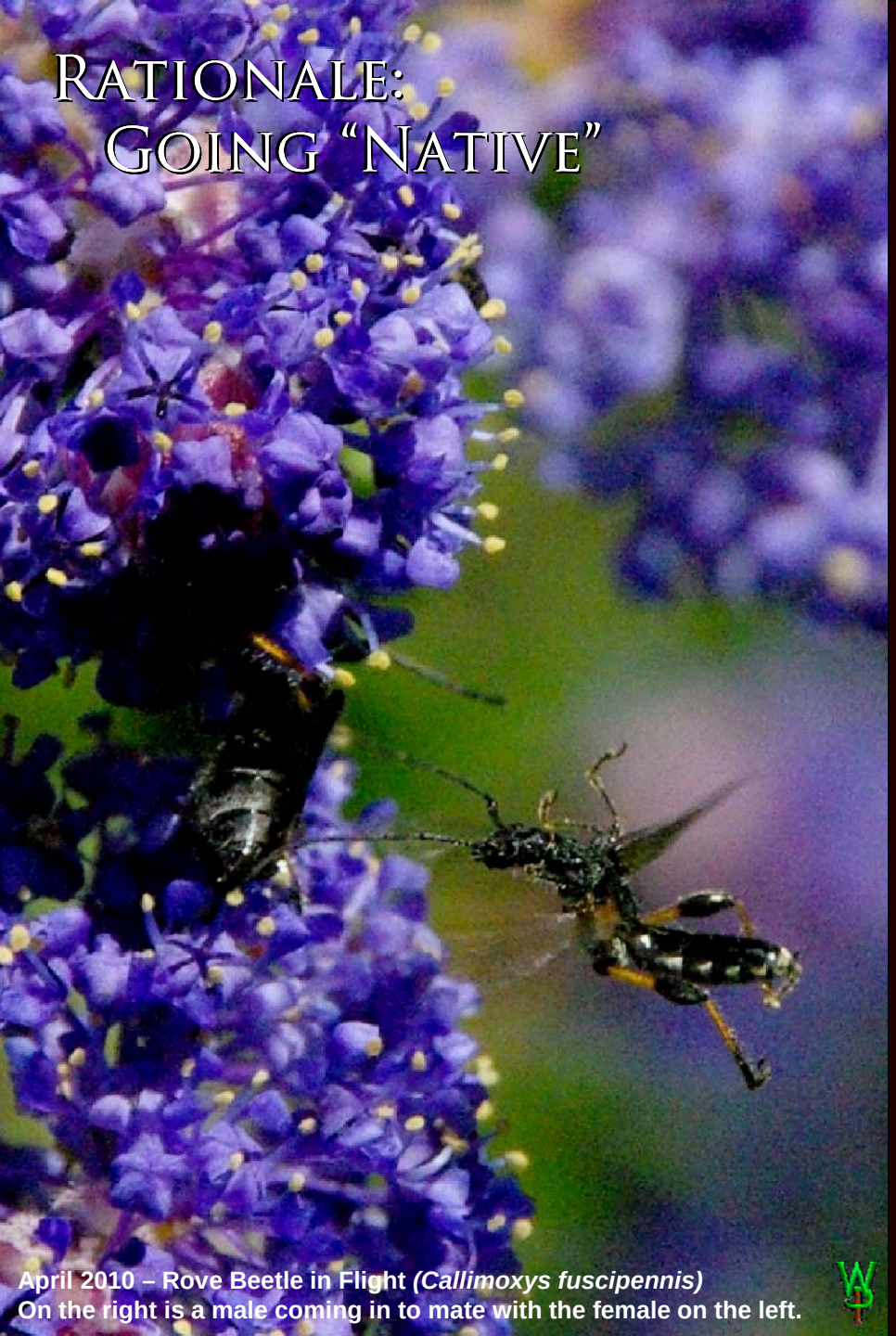
Rationale: Going "Native"



April 2010 – Rove Beetle in Flight *(Callimoxys fuscipennis)*
On the right is a male coming in to mate with the female on the left.

Plants are the most accessible means for people to manipulate the biological world. They have few defenses, stay put, and are relatively easy to propagate, develop, and multiply. Besides providing the bulk of food and materials for insects, people, and animals, they process nutrients for rivers and lakes that feed the estuaries that breed so much marine life. The ocean in turn processes 80% of the oxygen in the atmosphere, mostly along coastlines. Learn to manipulate plants and one can indeed hold sway over every bird of the air, fish of the water, and animals roaming in in swarms upon the earth, for better or for worse.

Native plants (especially post-disturbance annuals) provide the energy for their fungal and bacterial symbiotes that together combine minerals and gases into soil nutrients for the perennial systems that succeed them. Insects and animals need them to make proteins while the plants need the bugs for pollination and animals for soil fertility. Migratory birds not only consume insects and move seed, but may require plants that produce the fruits or seeds for which they are suited. Many relationships among insects and plants are host/consumer specific: pollination in return for food or for insect larvae accustomed to the toxins the host plant produces. Soil bacteria and fungi that process nitrogen and other nutrients often have specific relationships with their native plant hosts, and not their exotic counterparts. Hence, if that botanical foundation changes composition, the microbial basis of the food pyramid will be disrupted significantly over the long run, particularly if non-native plants take over after a disturbance such as a major flood or fire.

This Ceanothus papillosus (a.k.a. "tick bush") is a fruit-bearing shrub popular with birds during the fall migration. These should be fairly common. When we bought our place, weeds and overcrowded forests had progressed so far that none were left alive. We thinned the forest and removed the non-native brush. Lots of Ceanothus came up at the edges of burn piles, so I transplanted a good many. The bugs seemed to like the idea.

Wildergarten 5.2

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

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

Vande Pol, Mark Edward, 1954 –

Other writings by Mark Edward Vande Pol:

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

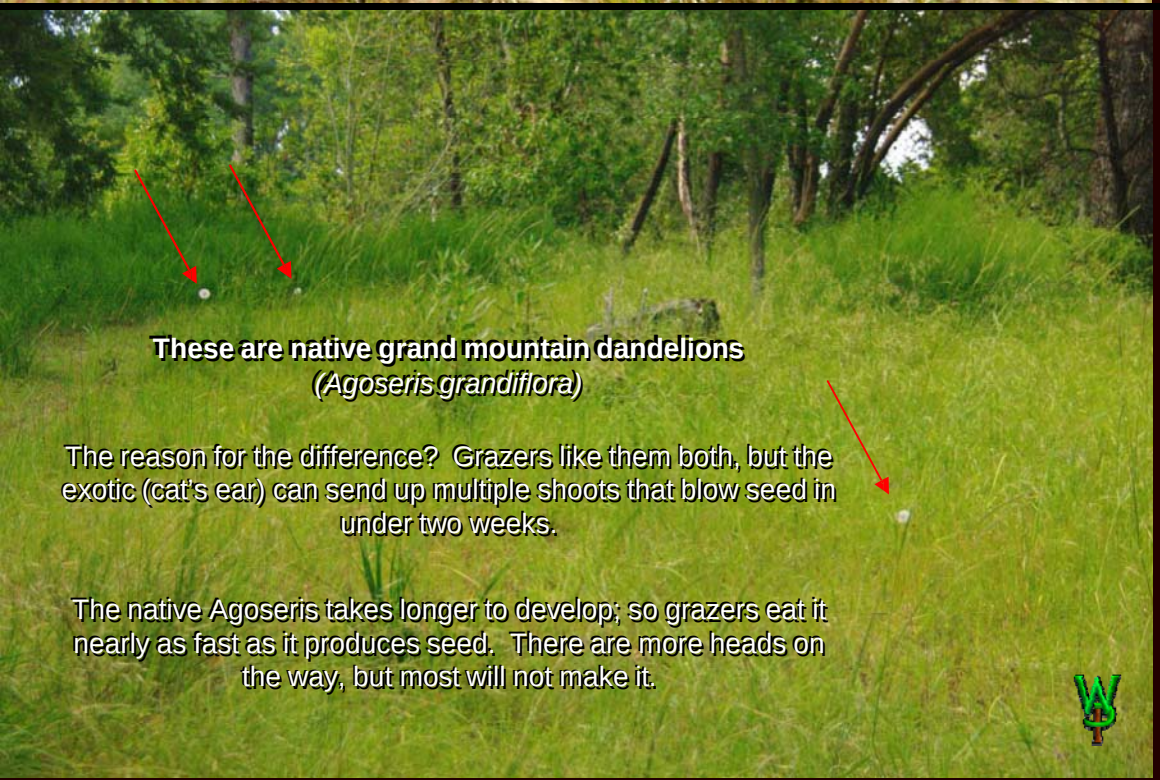
Shemitta: For the Land is Mine: ©Wildergarten Press, 2009. Contains: 217pp text, 980pp overall, 14 picture books, 2 tables, 963 photographs, 9 maps, 2 drawings, 2 charts, 145 footnotes, 358 citations, and 216 other source references, not including external Internet links. ISBN 978-0-9711793-1-8

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

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

A native successional system starts with mosses and bryophytes like these on this sandstone wall, which dissolve the compounds that cement sand particles into the stone beneath. That material then sluffs into piles along the base of this wall, beginning the process of soil formation. These piles are then populated with annual forbs (such as the clovers on a step in the wall in this photograph). These plants prepare the bacterial, fungal, and mechanical soil conditions for the perennials that succeed them. Unfortunately, these early post-disturbance plants are also the most likely to be displaced by exotics (many of ours were long gone). The little tan blobs on the wall *(Asterella palmeri* - inset*)* are so uncommon today that the County herbarium lacked a specimen (until I provided one).

The forbs then give way to grasses, although as long as there is disturbance, not completely. As you go through this book, please note how native plants form complex arrays of numerous species. Grasslands can be so killingly beautiful as to keep a guy maniacally weeding tiny invaders in a jungle like this for 15 years. I wish there was some other way to accomplish it, and there may be ways to reduce significantly the labor and elapsed time involved, but so far, there is no way to do this without some detailed hand-weeding.



For multiple species to reproduce in one spot, no one native can be too dominant. They've learned how to "get along with other children." Collectively, that lack of dominance may be one factor that leaves them so open to invasion. Non-native plants by contrast tend toward monocultures (top left). Most exotics wreck microbial soil productivity because they lack symbiotic relationships with microbial partners among bacteria and fungi with which to feed plant sugars to the soil system.

How these relationships work between plants and soil microflora remains largely unknown to science. Improving our understanding then requires having the nutrients, the genetic raw material, and a process of disturbance against which to observe system responses. That means somebody has to have a place to do that research with minimal disruption from exotics. In this region of California, the Wildergarten is as close as it gets.

Early on, things were pretty sparse here. The process started with making open niches (bare soil) waiting for natives to make an appearance, and then weeding around them as they colonized the place. Even after some were established, it is uncertain that their microbial soil symbiotes were still present. In some cases, they were clearly not.

The latter consideration is much more serious than many realize, for the lack of microbial associates (an unfamiliarity with the neighborhood so to speak) may be one of the reasons why plants behave as invaders or partners to a system. We have seen such "strange" behaviors even in native plants, as you will see in this chapter.

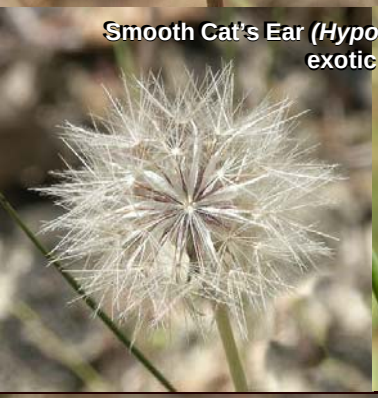
But before we go there, let's take a quick look at the disparity displayed at left.

Cat’s ear was such a disaster that I wanted you to appreciate this mess. 25-50 seeds per head. Imagine acres of it. It’s toxic too.

Besides, I just like the grand mountain dandelion better.

Annual Agoseris *(A. heterophylla)*
native

Silver Puff Dandelion *(Uropappus lindleyi)*
native



Smooth Cat's Ear *(Hypochoeris glabrosa)*
exotic

Of these dandelions, only cat's ear (on this row) is non-native.

If you think that native v. exotic is a distinction without a difference, please consult the images on the next page

Grand Mountain Dandelion *(Agoseris grandiflora)*
native

People often ask me how we know whether or not a plant is native. In some cases the determinants are easy**:** Some, such as redwoods, occur without human propagation in only one region of the world. Other evidences are more subtle but still definitive, such as fossils or pollen layered in mud found in stable ponds and lakes. A few cases are not much more than educated guesses. In fact, multiple errors in the botanical record have been disastrous for us and continue to be a challenge that has costs me dearly. Still, I would hazard that the determination of whether a species is native is probably better than 98% accurate overall. Yet the limits as to what constitutes "native" are potentially more subtle than we realize, as examples in this chapter will show.

Beyond nativity, it is certain that we know very little of how native plant systems were arranged and managed before Spanish colonization. There is very little data beyond explorers' observations and archaeological analyses. The records of first encounters by the Spanish are very sketchy but do offer inferences I will discuss. Brewer's diary of the 1860's US Geological Survey was more detailed but by that time the system had radically changed. We ***do*** know which plants we tend to find together now, but that doesn't tell us how they got along as native cohorts because the exotics are so dominant. Upon those and similar bases, how *could* we reconstruct whole systems, much less assess their value, given the many unknowns?

We are addressing that latter question. By ridding so much of the property of introduced plants, we not only get to witness how natives congregate, but how they colonize an open niche and work it out with their new cohorts. In many cases, the native seed bank had been exhausted for so long that we had to wait for birds and animals to bring something in. In most cases, those "somethings" had long been known to be local natives. The associations they form are qutie different from what you see with exotic plants.

The Wildergarten is amazingly varietal even for this region, and especially for a parcel this small. It is home to five distinct types of habitat**:** redwood conifer forest, oak and madrone woodland, native meadows of several types, scrub/chaparral, and the unique “Santa Cruz Sand Hill” habitat. It is a wonderful laboratory for observing dynamic behaviors among these plant communities over long periods of time. The only thing we’re missing characteristic of this area is a pond or perennial stream.

Yet even with that limitation, all told as of 2015, we manage 350 observed plant species, of which 224 are native, on only 14 acres in a place no botanist would call a biological “hot spot." According to at least seven local botanists and restoration experts (three of whom had been presidents of the local chapter of the California Native Plant Society), the Wildergarten is the purest restoration of native plants to be found anywhere on the Central Coast of California and perhaps in the world. Virtually every park, preserve, or “pristine area” in the region is significantly infested with exotic plants by comparison. Yet this place was once FAR from “pristine.” This place was a disaster.

Much of this book centers upon what it took to achieve these results. Not surprisingly, it has demanded a huge investment of time, money, and labor that is not over by any means.

Consider this little meadow close-up. Within ten feet, I have counted over twenty species (there are seven in the photo; several more have been weeded out). When I started the project, there were four species in this area, total. Now, imagine looking for 10-15 different target weeds amid this tangle, as fast as you can go. Hour after hour, day after day, year after year.

The goal here is simply to see how full compliments of native plants behave with minimal exotic intrusion. It has never been done on this scale before. What we have learned is that this system is quite different than the usual landscape in California. These plants exhibit complex interactions with each other and soil that are not described in the literature.

Another typical question is if there is anything inherently superior about native plants. To the surprise of many, I would argue that, on an individual basis, in most cases the answer is no. However, when one looks at how individuals behave within total systems, I would argue natives generally make more productive landscapes. The reasons are subtle and demand some explanation.

There are two ways to obtain materials with which to produce the physical products you buy**:** agriculture and mining. The first is in some respects the second, in that whatever soil minerals leave the site as products are also effectively mined. Eighty percent of the world's farmed products are grown on former grassland soils. So, any process that renews or increases the productivity of grasslands or makes them more resistant to problems would seem to be a good thing.

Consider the verbena at left (top). Although it is a perennial, it has the property of dying back every winter, leaving massive amounts of soil organic matter in the form of decaying roots and vegetation. Every spring, annual forbs germinate in that soil and die, leaving processed nitrogen, then to be covered over by the verbena. It then becomes a powerful moisture-retention blanket during the summer while providing an important source of pollen to hordes of bees for months.

Consider hedge nettle *(Stachys rigida)*. The roots of this genus exude sugars that feed nitrogen-fixing bacteria in the root zone (rhizosphere) similar to nodules on legume roots. These nettles do make beautiful soil and they don't sting. Such relationships may explain why we see so much growth here despite the fact that our sampled nitrate numbers are pitifully low. On the other hand, the site history (to come) possibly explains why some of our soils lack trace minerals for diazotrophic (nitrogen fixing) bacteria.

There is a lot of research to do, yet these and similar plants are in trouble. If you now realize that we do not know much about them, more significant is that we know a lot less about how they interact with each other without weeds and especially in soil, where microbial associations are very poorly understood.

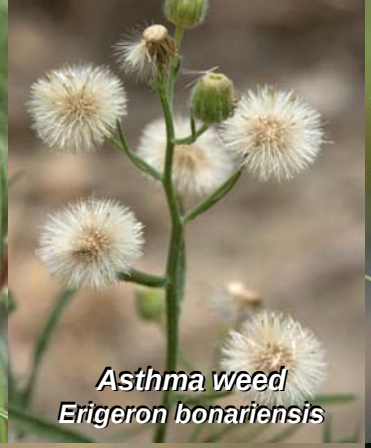
So, do I think non-native plants always bad?

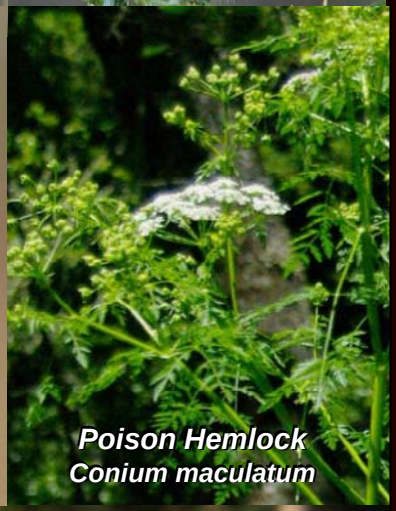
Well, of the 124 exotic species we have seen here, I have classified only ten (10) as "benign," meaning that they do not displace natives and tend to stay put within the system; in the vernacular, “they know how to get along.” Examples are relic landscaping plants on the property**:** an oleander, a mission olive tree, a periwinkle every year or two, a juniper shrub, and a patch of “naked ladies” *(Amaryllis belladonna)*. The rest of the non-native plants here all crowd out natives, in part because they can tolerate a far broader range of habitat conditions than the natives seek to colonize.

A good example is at left. Obviously, *Filago californica* (native, top) and *Filago gallica* (an exotic from France, below) are related. The native lives only in sand hills. The exotic lives anywhere there is full sun and bare soil. The exotic displaces the native, but it also displaces native clovers, lotuses, and *Navarretias* over a considerably larger range. The exotic once outnumbered the native in its *preferred* habitat, 50:1. After ten years of weeding, literally hundreds of thousands of removals, that ratio is now even. There is currently no way to separate the two other than by hand. As an annual job, it sucks.

But, don’t we want plants that are widely adaptable? Well, not necessarily**:**

- If we want systems capable of sustaining numerous species of insects and birds, the answer is no.
- If we do not want to displace numerous native plants in the wild, the answer is no.
- If we want varietal cohort species (such as soil bacteria) with which they are symbiotes, no.
- If we want the plants to get along with each other such that systems can perform multiple functions in the same spot, no.
- If we want adaptable systems as a whole, probably not.





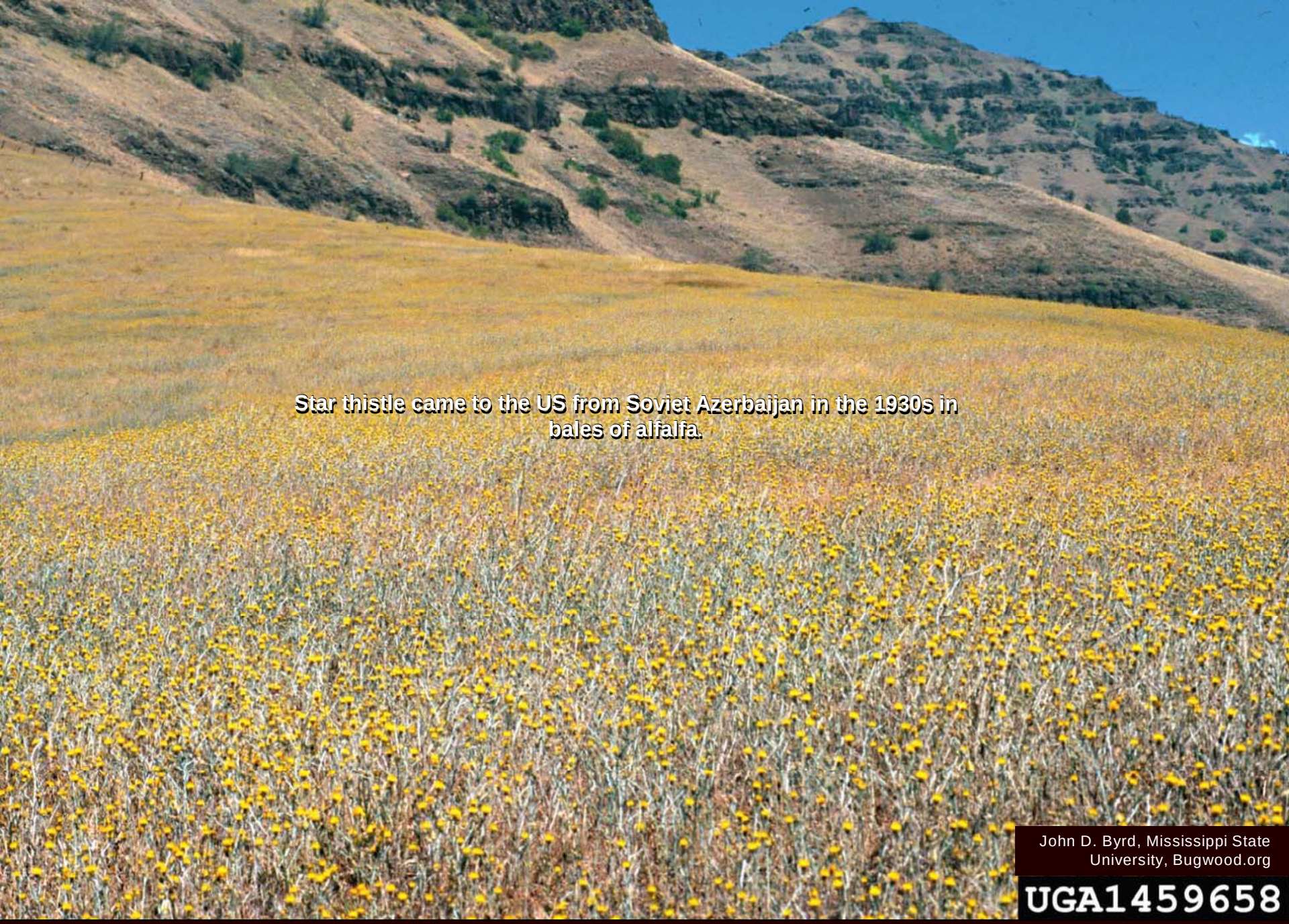
As a final element to this, “Are non-natives always bad?” question, almost all of the exotic plants we *are* talking about are those that people have already found to be generally undesirable for residential or agricultural use. Most would be considered "bad plants" just about anywhere. They are**:**

- At times inedible to humans, beasts, or insects,
- Allergenic irritants,
- They displace forbs that produce protein in forage,
- Many are toxic,
- They are very destructive to native soil fungi and bacteria that complex and distribute nutrients,
- Many cause mechanical injury to animals,
- Most have poor forage value,
- Many produce irritating burs,
- Most are water hogs,
- They are all virtually uncontrollable, and
- Most are fire hazards (at least they are here).

This does not mean that they have no *potential* use, as the examples of various vetches and poison hemlock (to come) demonstrate. One can make honey from star thistle. One can graze rip gut early. However, in this region, I really don’t know why anybody would *want* large amounts of them given their native alternatives.

Most people find most exotics undesirable, but seem equally unwilling to do what it takes to bring them under control, which is to… KILL THEM ALL. In general, most people either do not know or care what is native versus exotic or do not possess the means to exercise their preferences.

There are notable exceptions to that general public indifference to weeds**:** a special subset of "*invasive"* exotics that build monocultures, meaning that they tend to exclude all other plants until something worse comes along. These pests are displacing native plants, worldwide. The US Soils Conservation Service introduced kudzu as an erosion control… Well, it certainly worked for that!



… but other invasive exotics came in accidentally, facilitated at an increasing rate by global trade with neither inspections nor treatment.

September 2008 - Ranch along SR 198 east of San Lucas, CA

Some are subtle because we are so accustomed to their presence. “The Golden Hills of California” may be beautiful, but neither are these grasses native nor are they as productive for forage as others could be. Twenty-two million acres of annual grasses, particularly slender wild oat *(Avena barbata),* “poverty grass,” *(Festuca spp.*), and several exotic bromes such as rip-gut and Spanish brome *(B. diandrus & B. madritensis)* have displaced the perennials that would do as well or better. Palatable annual forbs have become scarce.

June 2015 – This is *Carex divulsa,* which did not do very well on this "Green Roof" over the Stanford University Hospital parking garage. To Stanford's credit, the roof has since been replanted but it still has weed problems.

In other cases, an exotic can be so subtle that even the professionals get it seriously wrong. In 2004, I was in the throes of learning what was native and what was not. I was also in too much of a hurry. So I bought 200 *"Carex tumulicola"* (foothill sedge) plants from a local native plant nursery specializing in large (and expensive) habitat restoration projects, usually for government agencies. Impressed with my efforts, I called in some botanists to look at the progress. Tim Hyland got out of his car, looked up the hill, and said (loudly), "There's that sedge Paul Kephardt is selling as *Carex tumulicola*." I asked him what it was and he said he didn't know, but it wasn't as advertised, to which the others agreed. I killed them all (the sedges, not the botanists), packaged samples, and sent them with some known *C. tumulicola* to the Jepson Herbarium at UC Berkeley. After a year goading them to do the ID work (sedges are very tricky), they punted them up to Dr. Eric Roalson at U. of Washington. By then I had guessed and he confirmed what they were**:** *Carex divulsa*, an exotic European sedge. This plant had been sold all over the State as a native, especially for said very spendy restoration projects and "green roofs" on government and university buildings. The interesting thing is**:** Although the experts in the native plant nursery business had been fooled by appearances, this exotic species did *not* do very well.

April 2015 – Bitter Cress along with hedge parsley on a site recently exposed by forest thinning

Other times, when the professionals get it wrong, the “subtleties” involved amount to gross negligence. When I first keyed this plant (with the upright brown pods), it was thought to be *Cardamine oligosperma* (native). In fact, it is “bitter cress,” (*C. hirsuta*), an exotic and a headache for the nursery business nationwide. To this day, the University of California Jepson herbarium says the exotic is not present in most of the State. Yet our seed bank indicates that it has been here for over 50 years**!** Interestingly, the native (since distinguished), is every bit as well behaved as the exotic is not. This distinction and its underlying chemical causes represent an important research opportunity that has been missed for all that time, one that could tell us a lot about why exotic species behave the way they do. This is indication of misplaced institutional priorities in the mundane business of management. There is no excuse for this.

January 2017 – *C. hirsuta* dominates germination in a spot that had been under Ceanothus for some 75 years.

Imagine working for a decade operating upon false information without any idea of the scope of an unknown problem. Once the problem was identified, I had gobs of natives that I didn't want to kill. So unless there was no other way, "starting over" was out of the question. The determinant is**:** How much of this weed is in the seed bank? This is a patch of recent gopher activity. What came up was almost entirely *Cardamine hirsuta.* This weed can germinate and release seed in only six weeks, making multiple generations possible within one season. I have to cover about 7 acres at least twice in that 6 weeks and find them all in order to have any hope of a reduction in the seed bank. It can put up a pod when it is but 3-4mm across. Sometimes it is dark purple, nearly the same color as the soil. It can mature in cool weather, which means the hand weeding I do must be done in the rain in order to have time to spray during the few hours warm and dry enough for spraying to be effective. So, I use chemicals in dense stands only because it is impossible to kill them all fast enough any other way. This mistake of basic taxonomy has been very expensive to me. Who is accountable for such obvious negligence in a system run by universities and agencies that clearly do not know what they are doing?

February 2015 – Bedstraw, aka cleavers, catchweed, stickwilly… the tangle in the middle

Well, in many cases, NOBODY knows what they are doing, because there are so many unknowns involved. This is believed to be *Galium aparine* (supposedly native), which I believe to be either exotic *Galium spurium* or (worse) a hybrid of the two! Nor is this a matter of mere curiosity, in that this plant is very destructive to agricultural crops and machinery. I kill it, because it was not here when we arrived, it first showed up next to where the garbage is picked up, and "it doesn't know how to get along," meaning that it is immensely destructive to native habitat. In its present form, it would have also been destructive to native American proto agriculture. I found a researcher who has some seed recovered from an archaeological dig and supplied her some fresh seed. Hopefully, she can run a comparative DNA analysis and find out if there is a difference. Yet, finding out it was native would not stop me from killing it. Why?

February 2015 – Year two of our latest entrant, *Gilia achilleifolia* as it spreads into a grassland of needle grass, clarkia, and various lotus and clovers.
It is invading, as hoped for. Is it invasive?

There are a host of things I cannot or will not do that make it impossible to manage this place identically to Native Americans. I don't eat many acorns. I don't harvest bulbs for starch. I don't eat grass seed. I don't collect tiny pods and grind the seeds to make gruel. I can't legally hunt for food. I can't broadcast burn in the summer with or without the fire department. I don't beat tarweed for seed. Nor is the full compliment of insect consumers present to consume the excess of these plants, nor can I host the large numbers of antelope, bears, and elk as described in the Spanish diaries without reintroducing and/or redistributing the weeds. Therefore, under the constraints of what I *can* do with what is here, it is entirely likely that some native plants will run amok and thence require some form of control or disturbance in order to sustain the complex biodiversity I see in so many different arrangements today. Moreover, every time a new plant comes back, the relationships reset as it invades the property. If I can keep the bad actors under a degree of control it may allow me to see how the plants work things out over longer periods to learn how to keep them all making fresh seed.

February 2-17 – *Sanicula crassicaulis,* seeding

We do have inarguably native plants here that can get “weedy,” in that they tend to build monocultures and do not seem to “get along” with other local plants. So, is this due to a lack of regular fire, or is it something else? Above is Pacific sanicle *(Sanicula crassicaulis)*, which may simply lack a biocontrol, in this case a moth whose larvae would otherwise eat much of the seed. That moth might be *Greya reticulata* which is known to chew on sanicle but also on mountain sweet cicely *(Osmorhiza berteroi)* a nice plant which gets along fine. Which plant does the bug prefer? How do I get some larvae? How much is enough to start? How would I reverse course if I didn’t like the outcome? Does anybody do this kind of research? Well, yes, but mainly on exotics so as to avoid chemical control.

So, we have encountered instances for which there were legitimate questions of nativity. Some were later found to be very destructive exotics. Others not so much. Some were destructive natives. Yet that such ambiguity exists after 15 years of work is indicative of serious problems in our environmental management model, one in which science responds to political and academic interests at the expense of distributing accurate and timely information to its users, for which, effectively, no one is accountable despite the costs.

When I first identified this plant using the 1993 Jepson Manual, it keyed unambiguously to *Gnaphalium purpureum*, a native. Accordingly, I allowed it to spread because it obviously suppressed weeds (2010 photo). Then, upon observing that it was suppressing *everything* to the point of destroying one of my meadows, acting on intuition, I killed it here before the situation got worse, I confined it to a known area, pending learning more through observation over time. I weeded it everywhere else.

Determining if a plant is an unidentified exotic species involves obtaining and studying foreign plants and botany texts to figure out what belongs where, a study I cannot reasonably perform. Yet I had just noticed "something wrong" and simply taken action. Is that really scientifically justified?

A new key by Guy Nesom in the 2012 Jepson e-flora rendered its identification as *Gamochaeta argyrinea* (an exotic South American plant) for which there is no record in this county. Fearing that the botanical record had been in error (it wouldn't be the first time), it was not difficult for me to chase down and kill the rest, attaining full control that same year. Yet strangely, in one of my more original and undisturbed meadows, this plant was not a problem. So the question remains as to why it displaced natives in one place but not so easily in others that had suffered less disturbance. The reason may well be microbial. Interesting, isn't it?

So, I sent Dr. Nesom some sample pressings. He came back with *G. ustulata,* the new name for the native! Now what do I do? Confine and observe. This is how complicated things get, because science really doesn't know as much as the politicians and activists would have us suppose. It may simply lack a predator, or fire.

This is not easy work, physically, intellectually, or emotionally. It is a challenge for human beings to protect the land around us while aware of our own ignorance with the knowledge that doing nothing can be worse. It involves persistence, frustration, risk, and an enormous amount of work. Yet is immensely rewarding.

May 2010

And here is a candidate cudweed “predator” known to be “a professional cudweed muncher”**:** *Vanessa viginiensis*.
As a butterfly she is also known as the painted lady (and she is beautiful)! I’ve seen a few, hopefully soon we’ll have many more!

February 2015 – *T. ciliolatum v. ciliolatum* displacing *Acmispon parviflorus* and *Trifolium microdon*

This next example gets ethically murky! This is *Trifolium ciliolatum v. ciliolatum*, inarguably a California native plant. Yet this *variety* of *T. ciliolatum* has never been recorded this far south. It does "get along" with the local soil bacteria in that it forms profuse nodules containing nitrogen-fixing bacteria (inset). It is at least competitive with the native *Stipa* grasses (unlike most of our local clovers). HOWEVER, it also tends to form monoculture patches wiping out virtually all other native clovers (this is a relatively small patch but an obvious example). So, does this new "native plant" variety "belong here" or is it an alien? In some respects, it certainly *behaves* like an alien! This will be discussed at greater length in a chapter on native colonization behavior in Part III of this book.

This is the local *T. ciliolatum v. discolor* (circle) hanging out with friends. This business of 'knowing how to get along,' insofar as "native" plants are concerned, is more important than one might suspect. In several instances, my personal and subjective intuition based upon observations of the behavior of questionably native plants in and among indisputably native plants has been shown to be at least arguably correct despite supposedly authoritative documentation to the contrary, some of which was later proven to be wrong. Nor am I alone among experts in the field in possessing these opinions. In the case of *T. ciliolatum v. ciliolatum*, I had noticed a potential "problem" well before I knew it had never been seen in this area before. Effectively, there is something about a native system that speaks to human intuition before it can be resolved explicitly. Unfortunately, nobody else I know has one to observe. Maybe there is hope for us after all. Yet the limits of ambiguity are not the only problem with "native."

There are also practical limits as to goals in restoring native plants. According to the Jepson Manual, Chilean (aka “Coast) Tarweed *(Madia sativa)* is native. Upon observing its behavior, I have my doubts, as it readily builds monocultures here. The problem with *M. sativa* is that, after weeding in it, one literally feels as if coated in contact cement. It is such a pain of a plant that I have seen papers from both North and South America each accusing the other of being the source! So, even if it is native (I *still* have my doubts), I kill it for the simple reason that **making the guy who weeds this place miserable is bad for this place**. Everything this plant did for soil fungi in this system is accomplished just as well by Slender Tarweed *(Madia gracilis),* which “knows how to get along” just fine.

June 2015 – This is a diverse mix of 100% native annual and perennial cover only one year after a disturbance.
It has already precluded most native annuals (there are a few tarweeds and sanicle).
It will soon be overwhelmed by the native blackberry, then shrubs, then trees…

This chapter illustrates one of the key points in this book introduced in the prior chapter, that just because one has "restored" a place to all native plants does not mean that the native *system* is restored. Repeatedly, I see projects comprised exclusively of perennials installed in such intense density as one would NEVER see in the wild with the sole purpose of crowding out weeds. I am not saying that there is anything intrinsically wrong with this "suppression" strategy (I use it) as long as it is temporary. Yet eventually, there **will** be a disturbance (fire, flood, gopher, or fallen tree) such that the niche will open and the weeds will reassert themselves. I am saying that without post-disturbance native annual plants (what we have been doing for fifteen years), the successional system is lacking its microbial foundation. Annuals is where the hard part of restoration actually begins. And we begin discussing that in the next chapter.

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