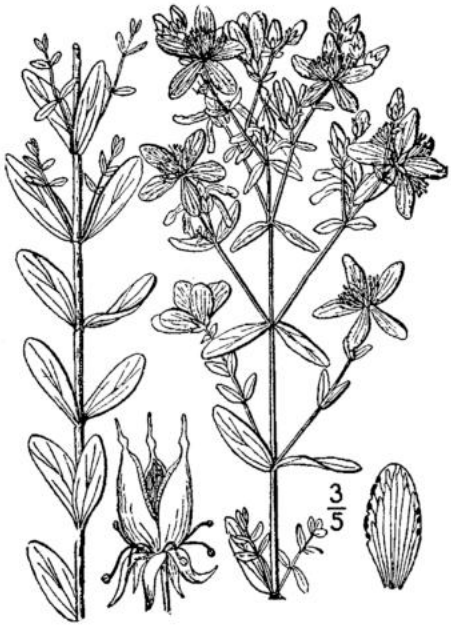
The Troubles of "Invasive" Plants



St. Johnswort (Hypericum perforatum)

Issues of identification, control, restoration, climate change & culture

Introduction by the authors

The two of us are plant lovers. We love all plants, domestic and wild, native and introduced, ancient and ephemeral. We have dedicated years of our lives to the nurturing, propagating and protecting of plant life, as farmers, wildtenders and activists.

So we are deeply saddened about the war against the earth as we have witnessed it in the USA. Among the historic and ongoing massacres are the wiping out of the wetlands (50% drained), the decimation of the Redwoods (96% cut), and the virtual erasure of the Tall Grass Prairie (over 99% plowed under). Add to these the current pillaging of the mountains, deserts and valleys by mining, ranching and agriculture. Poison flows in the waters, taints the air and is bound in the soils. Wildlife populations of animals, plants and insects are plummeting. The climate crisis is intensifying at an increasing rate. The possibility of near-term human extinction is the subject of serious discussion.

The two of us have walked through clear-cuts, surveyed cattle-stomped indigenous gardens, and seen landscapes scraped clean for solar farms. We have also slept in old growth forests, sown the seeds of wild foods, and made plant medicines. Deep love cannot stay quiet or sit still; it must express itself in practice, in everyday life.

On the topic of so-called "invasive plants," we don't have an axe to grind, but there sure is one we would like to dull.

Too often, as soon as the word "invasive" comes up, all discussion shuts down and the saws, shovels and sprayers are brought out. As if just saying the word settles everything.

Consideration of context? Irrelevant. Exploring non-lethal options? A waste of time. Questioning the concept? Blasphemy!

But real world implications follow the taking of life (see above) so any school of thought that demands death should be subjected to rigorous scrutiny. We owe that to the plants, the planet and ourselves.

As it turns out, the claims of "invasion biology" are not as unshakable as some of its cheerleaders might lead one to believe. In scientific circles, a real, serious debate about its premises and implications has been going on since the field emerged in the mid-20th Century, and continues in the present day.

As it also turns out, since the late 1990's, chemical giants including Monsanto have played a role in promoting invasion biology and the attendant use of their herbicides. There's a familiar story: corporate greed perverting science for profit.

In our opinion, calling a plant "invasive" shifts the blame from cause to outcome, obscuring the truth of the situation. At best, then, the label is a bait-and-switch but at worst a baseless accusation that leads to needless suffering. We oppose these scenarios and are urging honest appraisals and considerate responses.

We realize that we are stepping into contentious territory by questioning the invasives narrative, but, like the Lorax, we must speak for the trees.

Nicole Patrice Hill & Kollibri terre Sonnenblume

Occupied Pomo Territory, 7 January 2019

"Thirty years ago the greatest threats to nature were chainsaws, bulldozers, and poisons. Now the greatest threats are wild plants and animals. And what do we use to fight them? Chainsaws, bulldozers, and poisons. Who does this serve?"

—David Theodoropoulos, 2003[1]

Contents

What is "invasive"?

Determining the meaning of the word “invasive” is a slippery proposition.

The U.S. federal government defines an invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.”[2]

The National Wildlife Federation elevated environmental considerations, describing an invasive as "any kind of living organism... that is not native to an ecosystem and causes harm."[3]

The Connecticut Audubon society is less discriminating about the effects of introduction. For them, an invasive is any “non-native species that has been introduced, either intentionally or accidentally into a new habitat or has escaped cultivation.”[4]

A plant species doesn't have to venture far outside its native range to be considered invasive. Such is the case of the endangered[5] Monterey Cypress (Cupressus macrocarpa), which “is a frequent target for the chain saws of the San Francisco Recreation and Parks Department—even though two small stands in Monterey, just fifty miles south, are cherished and protected as natives.”[6] Meanwhile, a 500 mile drive north of its relict range, a large specimen planted by European settlers in the 1850's is an officially designated “Oregon Heritage Tree,"[7,8] which we assume grants it some safety.

The State of New York includes a native plant, Silphium perfoliatum, on their “Prohibited and Regulated Invasive Plants” list because its growth is “aggressive.”[9] Here the non-native requirement has been dropped entirely because the plant has committed the crime of thriving.

Similar accusations—of “encroachment” by native flora—are currently playing out with tragic circumstances in the western USA, where native Pinyon-Juniper forests are being eradicated.[10] Juniper is now being called a “native invasive” by some.[11] (We discuss this atrocity below.)

Excluded from the label are domesticated non-native plants on farms, which is not insignificant, considering that over one fifth of the land in the lower 48 states of the USA is cropland. That's nearly 400 million acres of what was originally habitat for many, many native plant species. The excuse of “Well, we need to eat!” doesn't fly here; only 20% of this cropland is devoted to growing food directly for US Americans; the remainder is for ethanol production, export industries and livestock feed.[12]

Other exemptions apply. As the US Department of the Interior's Invasive Species Advisory Committee points out: “Kentucky bluegrass would be considered an invasive species in Rocky Mountain National Park in Colorado, but considered non-invasive a mere 60 miles away at a golf course in Denver.”[13]

It should come as no surprise that one particular human-engineered landscape, though dominated by non-native plants species, nearly always get a pass, and that's... the residential lawn.

Commercial interests have also been involved in defining what species are invasive and in drafting the official policies that guide the “management” of such species. As we discuss below, Monsanto has played no small part in the US federal stance. They and other chemical companies profit from the sale of herbicides used in “restoration.”

Though there is no consensus on the meaning of the word, “invasive,” the destructive effects of policies that aim to eradicate such plants are beyond doubt.

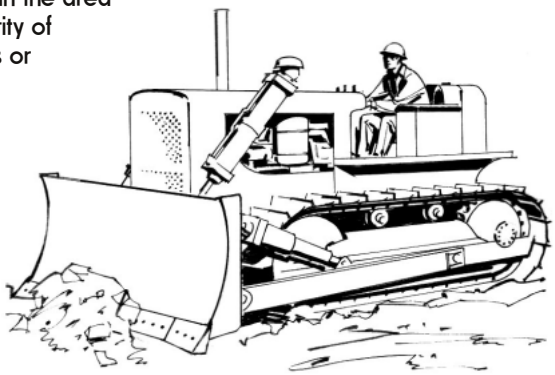
COLLATERAL DAMAGE

A survey of common methods of invasive plant control

"Invasive" plant species are removed using a variety of methods that can be classified into three broad categories: mechanical, biological and chemical. All means in these categories have their own varying rates of success and drawbacks. As practiced, few are effective at removing their targets without killing non-targets, and only then at very small scales. As the size of a particular project grows, so does the likelihood of unintended consequences and collateral damage.

Mechanical control

Mechanical means include mowing, tilling, weed-whacking, smothering (with organic materials like mulch or synthetic ones like nylon fabric), soil solarization (covering the ground with plastic to kill plants and seeds), flooding (or alternately draining water if the target species is aquatic), prescribed burning, and simply pulling, hoeing or chopping by hand. Each of these processes varies in its precision (as measured by how many non-target species are also affected). Some, such as flooding, burning or smothering, affect all plants in the area of application. The particularity of others depends on the tools or materials used and on the operator's skills, attention and concern. Unfortunately, it's too often the case that operators lack those characteristics or are not properly equipped. The result is damage to non-"invasive" plants, the ones whose well-being is ostensibly of such strong interest.



In some cases, entire landscapes are scraped of all vegetative life. In the example of a project to remove European Beach Grass on a beach in Oregon, before and after photos document a process whose "success" resembles a moonscape.[14] One is reminded of the adage, "We Had to Destroy the Village to Save It."[15]

Further, non-target species are not limited to plants. Animals can also be displaced, injured or killed by all of the above methods. Burrowing mammals and reptiles can be chopped up, buried, asphyxiated, drowned or have their homes excavated (like the time I accidentally cut a Skink in half with a shovel blade while weeding a garden). Insects are harmed in their various life-stages, during some of which–caterpillars in cocoons, for example–they are unable to attempt escape. Fish and other aquatic creatures might lose an entire generation if their eggs are nestled in plants exposed by lowered water or buried in muddy lake floors that get covered by a "benthic barrier." (Benthic barriers are sheets made of plastic, nylon, or burlap that are used to smother weeds underwater and which reduce or eliminate sunlight, deplete oxygen, and lead to gas production from decaying matter.[16])

The time taken to recover from the disturbance made by mechanical means differs depending on method, climate, season, etc. A quick bounce-back could be expected in the case of a careful individual digging up of blackberry canes in the US Pacific Northwest in springtime, for example. By contrast, a much longer time is needed when a Pinyon-Juniper woodland is "chained," a process in which a very large chain is dragged between two tractors, uprooting everything in its path. Not only do trees need multiple decades to grow back, but the time required for certain soil-borne mosses in these ecosystems to completely regenerate might be well over two centuries.[17]

Additionally, mechanical means can actually encourage the reproduction of particular plants that thrive on certain disturbances. For example, Bindweed (the common name of several vining species in the Morning Glory family, most commonly in the genera Convolvulus or Calystegia) is very effectively spread by getting dug up or tilled under. A severed root fragment of as little as half an inch in length can produce an entirely new plant. This characteristic of Bindweed is well known in agricultural circles and we made the discovery for ourselves during our farming years.

Compared to chemical methods, mechanical ones can more easily be limited to target species because of their hands-on nature. However, they are usually more expensive than chemical methods due to equipment needs and labor hours, and so are often eschewed for that reason. Too often, saving a buck is more important than doing the best job.

Biological control

Biological methods entail introducing additional non-native species that will consume the target plant. Most commonly, the new species are insects native to the target plant's original habitat who were predators of the plant there. Ideally, the new species consumes only the target plant (i.e., has "host-specificity"), but it hasn't always turned out this way. Warns the U.S. Fish and Wildlife Service (FWS): "Classical biocontrol is irreversible and therefore it is essential that all potential consequences are adequately considered beforehand."[18] Of course, it is impossible to foresee "all potential consequences." That means trouble of some kind.

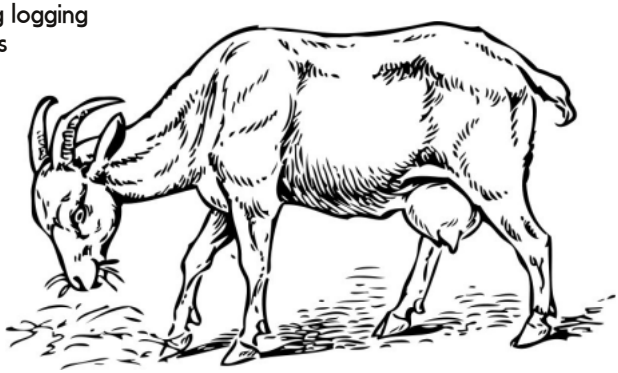
FWS lists a few ways in which introducing new species as a biocontrol can backfire.[19] These are not hypothetical. Each one has been documented.

Non-target Attacks and Host-Shifting: Despite prior research, new predators can expand their diet to include non-target plants after they have been introduced. Such plants might be native or agricultural, so the damage can be ecological or economic.

Accidental Introductions: Despite care with collection and transport, other species can accompany the intended one. Cites the FWS: "For example, the pathogen Nosema was accidentally introduced as a contaminant of a weevil (Trichosirocalus horridus) introduced to control musk thistle." Nosema[20] affects Honey Bees and is a possible cause of colony-collapse disorder.

Food Web Interactions: An introduced species can throw off the balance in an ecosystem. FWS relates the case of a gall fly introduced to control a non-native plant that ended up becoming "superabundant" itself. This led to a 2-3x increase in the population of Deer Mice, which raised concerns that they might over eat native plants.

Cornell University's College of Agriculture and Life Sciences lists over forty species of insects[21] currently being used for biological control of "weeds." One example is the so-called, "Klamathweed Beetle" (Chrysolina quadrigemina),[22] which was released into the wild in California in the late-1940's to control St. Johnswort (Hypericum perforatum), a plant that Europeans imported in part for its medicinal uses. St. Johnny, as some herbalists call it, has become widespread throughout disturbed areas such as agricultural zones and along logging roads. Despite the voracious appetite of the beetle–which we witnessed ourselves in herb gardens where we were tending the plant for harvesting–the plant remains common.



Not at all incidentally, the primary concern with St. Johnswort is that it causes phototoxicity in sheep. So the issue is economic, not ecological, and is being

undertaken in the interest of a species that is itself non-native. Furthermore, though it is often claimed that the plant pushes out native plants in the disturbed areas where it thrives, we could not find any sources that actually demonstrate that allegation. For example, one article[23] that is repeatedly cited to back up that claim merely restates it but offers no data or additional citation. In fact, the article is not even about the growth habits of St. Johnswort at all, but about the use of aphids as a biological control against it in Australia. One might be forgiven for wondering if the numerous people citing this article actually read it.

Domesticated animals are also used to eradicate invasive plants, but their role in these efforts is quite small compared to other methods. More significantly, cattle and sheep have played a major role in the distribution of non-native plant species, and in some areas–such as the arid non-agricultural west of the USA–have been one of the main vectors. Brush goats (Capra aegagrus hircus) have been increasingly popular in recent years–including in urban areas–but they will famously eat virtually anything (including plants that are toxic to them) so care needs to be taken.

Chemical control

Chemical methods for eradicating invasive plants are the most common because they are cheap and effective. Of course, they are also effective at killing non-target plants, and that result is quite common. In fact–and shockingly–less than 1% of a sprayed herbicide application ends up being delivered to the intended target.[24] The remainder–if one can use that word to mean "the vast majority"–is dispersed into the surrounding environment. As a science, it's quite a far cry from "exact." A 1% success rate in just about any other endeavor would be considered a dismal failure.

What do the "extra" chemicals do? Let's look at glyphosate, the most commonly used herbicide in the world,[25] which is manufactured by Monsanto and is the active ingredient in their notorious product, Round-Up. As a "broad spectrum" agent, it kills many kinds of plants, both terrestrial and aquatic, including algae. Sublethal doses are also harmful and lead to higher rates of fungal diseases and lower rates of micronutrient uptake. Additionally, glyphosate destroys beneficial bacteria and microorganisms in the soil, complicating recovery for native plants who no longer have the soil components required for health. As if that wasn't enough, the bacteria that break down herbicides increase in number, further throwing off soil balance.[26] Soil structure is also detrimentally effected by the way glyphosate binds with soil particles, which can lead to lower crops yields (and defeats the point of using it).[27]

In the Animal Kingdom, glyphosate is also highly problematic. It can "cause genetic damage in fish, and also disrupt their immune systems… can cause genetic damage in insects… landl can harm amphibians in a variety of ways, including causing genetic damage and disrupting their development."[28] In humans, "symptoms of exposure to glyphosate include eye irritation, burning eyes, blurred vision, skin rashes, burning or itchy skin, nausea, sore throat, asthma and difficulty breathing, headache, lethargy, nose bleeds, and dizziness" and it has been associated with "increased risks of the cancer non-Hodgkin's lymphoma, miscarriages, and attention deficit disorder."[29]

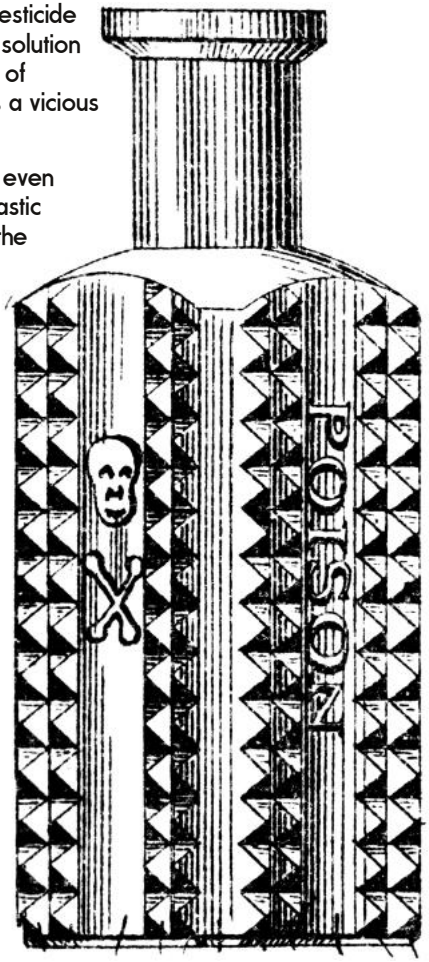
For years, the dangers of glyphosate to humans had been considered a matter of debate, but in a landmark court case in August 2018, a jury ordered glyphosate-

manufacturer Monsanto to pay $289 million in damages to a California grounds keeper who was dying of Hodgkin's lymphoma.[30] With this precedent set, further lawsuits are expected. This is good news.

The use of any herbicide at all that kills non-target, native species reduces the area's biodiversity, and not just of the plants. Any animals and insects that depend on those plants are also impacted. Furthermore, these holes punched in the ecosystem adversely affect the natural processes of succession that previously existed. Herbicides take the story "off script," so to speak, and there's no guarantee the remaining players will be able to improvise themselves out of their conundrum.

Direct exposure to herbicides is not necessary to suffer from them. Through a process known as "biomagnification," levels of toxins increase in the natural food chain. So, a tainted plant is nibbled by a mouse who is eaten by a snake who is caught by a bird of prey. Not only is the bird poisoned, but the resulting level of accumulation is at a higher concentration than would happen through direct exposure.[31]

The more that herbicides are used, the more that certain target plants can adapt and survive. "Pesticide resistance" has become a real issue, and the solution so far has been to apply more poisons, which of course leads to more "collateral" damage. It's a vicious cycle that we cannot afford to continue.



But there are definitely "conservationists" and even "environmentalists" out there who are enthusiastic about dumping poisons on living things when the targets are invasive plants. Something about the "invasive" concept works to sweep aside thoughtfulness.

Writes author and ecologist, Ken Thompson: "Alien species seem practically designed to excite public concern. Almost by definition they are most abundant, and most visible, in the most highly human-modified habitats, such as towns and cities. Personal encounters with aliens are routine, so everyone has an opinion, and it's often 'obvious' that aliens are actively supplanting natives, even if that isn't what's happening at all. It's equally 'obvious' that something must be done, even if it's not clear what that should be, and even if ill-judged intervention might only make things worse."[32]

It is our stance that herbicides are always an "ill-judged intervention" in restoration. If that seems extreme, that's only because invasive ideology has pushed the mainstream of discussion to such an extreme place, where the perverse logic of war has been made commonplace.

Nikki's not-so-Excellent Restoration Adventure

I first heard the term, "invasive species," while studying environmental science and botany in college (2005). I remember it being a way of describing the relationship of certain species in an environment that had experienced systematic disturbance, not as a way of labeling particular species themselves. The focus was on how repeated disturbances disconnect the landscape, leaving isolated patches of land that are no longer acting together as a continuous whole. Farms and ranches, cities and suburbs, clear-cut forests, roads (and border walls) are all examples of repetitive patterns of disturbance that result in large-scale fragmentation. The term, "invasive" was presented as describing a symptom of such fragmentation, not for labeling a cause of trouble in and of itself.

At that time, concerns about herbicide use for habitat restoration were a major topic. Multiple class discussions covered the repeated failures of their use and of their persistence in the environment, especially in riparian habitats (along waterways). It was well-documented that Monsanto's glyphosate herbicides behaved very differently in water than in soils, and that they were longer-lived and more toxic after seeping into the groundwater. Multiple efforts had already been made to reformulate herbicides to be less toxic only to find—after a few years of widespread use—that they were worse than the prior formulas. There was no dispute about the findings presented. My coursework led me to understand that herbicides were not the answer for restoring balance to an ecosystem, and that everyone in the field was aware of the risks.

Learning how ecosystems function with such intimate interconnectedness sparked a passion in me to work with the natural environment, and particularly habitat restoration work. At that point that my true learning began, and it entailed disillusionment, unlearning, and finding a path to real understanding...

My first job was doing plant surveys for the Nature Conservancy, an organization I admired at the time for their model of buying up and preserving land. I tremendously enjoyed spending everyday outside on my belly identifying seedlings, getting up close with all those little lives. The parcel I was working contained an entire watershed in the coastal Pacific Northwest, and included a variety of forest-stand ages from recent clear-cuts to relict old growth patches. The study was monitoring plant community changes after timber-thinning to see how succession could be encouraged at a faster rate. That is, since so many climax communities (old growth) have been destroyed, were there faster ways to bring them back? In hindsight, it seems that these efforts to hasten succession give permission to continue the degradation. And, when I visited the watershed years later, the huge amount of woody debris from thinning made it impossible to access the forest floor, which disrupted and fragmented the landscape. While

I found the survey work interesting intellectually, it lacked something for me personally. So many studies showed how badly ecosystems were damaged, but the collective response remained painfully slow.

My next position was with Americorps, working for a utility company with a restoration program. Again it was an example of giving permission for degradation, as utility companies are required to have such programs to mitigate for dams. Their subject was abandoned agricultural land along waterways. The main project that year was a 33 acre plot. It quickly became apparent that there was a rigid protocol to follow, with no leeway for adjustments, even if the clear result was failure.

First, the project started with repeated herbicide application right along the creek to clear out the unwanted plants presently living there. I was was assured it would be applied by a professional, but his wobbly stance and inability to focus his eyes seemed to attest to his long-term service around poisons. I watched as he careened down a line of Blackberries, spraying both the bushes and the air above the creek. It was clear that "professional" did not equal "trustworthy" or even "effective." It certainly didn't mean using the product carefully.

Second, no other site preparation would be employed. We would just plant climax community species into a disturbed habitat by the thousands, ignoring any concept of natural succession. (Some plant species will only grow and thrive when following other species, for example in their shade.)

Third, the labor for the project was comprised of volunteers and convict crews. The convict crews had no choice but to participate, so there was little point in expecting heartfelt motivation from them. As for the volunteers, their inattention betrayed a serious lack of engagement with the task at hand. I saw trees planted upside down and stepped on repeatedly. I observed the most enthusiasm in the devouring of donuts and chugging of coffee while feeling good about oneself. No one was truly present with the living beings they were working with.

The fourth and final straw for me around the standard protocol was the reporting component. In order to secure continued grant funding, we needed to report a certain rate of success. I was sent out some months after planting for a total of two days to record how many trees made it. From my on site data, I estimated a survival rate of less than 50%. But what was recorded in the books—and used for grant applications—was a survival rate of greater than 85%.

So, let's sum up this standard protocol: first, apply herbicides that are known to be environmentally harmful. Second, ignore natural patterns of recovery. Third, utilize uneducated, ineffective labor. Fourth, lie about the results in order to repeat the whole process.

Next time you hear about a "successful" restoration project, but aren't given any details, keep this story in mind.

Are all projects executed this badly? No. Some are undoubtedly worse. And some are better. Yet regardless, false premises underlie every one of them.

Fear & Loathing on the Olympic Peninsula

In 2014, we briefly moved to the Olympic Peninsula in Washington state to try to farm. To our great disappointment, the county happened to be ending a twenty year moratorium on pesticide use. The reason? To combat “noxious weeds” and “invasives.” No documentation was produced that “invasive” species had increased during the previous two decades, necessitating the switch.

In that particular county, a plant could be designated “noxious” through a nomination process. For example, Wild Chervil (Anthriscus sylvestris) had been added for carrot seed farmers at some point back in the day, not because it was non-native but from a fear that the plant would play host to Carrot Rust Flies (Chamaepsila rosae), and then infest their fields. Is that a legitimate worry?

Carrot Rust Flies can indeed be a serious problem for carrot farmers, and so there is a body of literature produced by ag schools and extension services in the Pacific Northwest that discusses in detail how to control the flies both conventionally and organically. But in our survey of this material, we found only a handful of references to Wild Chervil as a possible host crop (along with other members of the Carrot Family), but no recommendations to wipe out entire populations of the plants, certainly not outside the fields.

But in the spring of 2014, the county started spraying herbicides on patches of Wild Chervil along the roadsides. Land owners were faced with the threat of the county coming to spray on their property if they didn't “take care of” the Wild Chervil themselves.

Was this change in policy due to an outcry from local carrot seed farmers? Not at all. If indeed any carrot seed farmers even remained in the area, they had obviously been getting along fine for twenty years without spraying.

No, this new round of unnecessary “control” had been spearheaded by a single individual, a woman who successfully applied for grant money to pay her wages for eradicating “noxious” and “invasive” species. She was a registered Democrat who proudly called herself a “conservationist.”

The owner of the land we were living on was strongly opposed to the whole ordeal in general, and had been trying to protect the peat bog there. He decided to mow the flowering Chervil to avoid the county spraying, and was devastated to see a bunch of birds fleeing the patch as he proceeded. He was sure he was destroying nesting sites.

But there it was, on the “noxious weed” list, so none of these facts—or lack thereof—were of any relevance. We don't know if there was a process for “de-listing” a plant, but we ended up leaving the area for other reasons shortly thereafter. We never forgot, though, what we had observed: how the legal process for justifying the use of herbicides was led not by scientific facts but by commercial interests, which in this case were apparently acting from erroneous assumptions.

Was this a single, isolated, unique example of such? That is, of ignorance or money trumping facts or good policy? Hardly. If that's not a dominant pattern in US American culture and governance, we don't know what is.

Feds (and Monsanto) Sound "Invasive" Alarm!

The story of how the invasive species concept came to such wide public prominence starts in the late 1990's.

Although invasion biology was inspired by the 1958 publication of Charles S. Elton's "The Ecology of Invasions by Animals and Plants," that book did not attract much attention for decades, even among biologists. It would not be scientific interests that would fuel the charge, but commercial motivations.

A watershed moment came on Feb. 3, 1999, with the issuing by President Clinton of Executive Order 13112, which created the National Invasive Species Council (NISC). The order defines an invasive species as "an alien species whose introduction does or is likely to cause economic or environ-mental harm or harm to human health."[33] Note that "economic" precedes "environmental." That's no accident.

Back up two years to 1997, when the President's Committee of Advisors on Science and Technology (PCAST) set up the "Biodiversity and Ecosystems Panel" to make policy recommendations about a range of environmental issues including invasive species. PCAST's membership was comprised about half/half of people from academia and the corporate world. From the latter were representatives from Hewlett-Packard, Lockheed Martin (because apparently the military-industrial complex has to be involved in everything), D.E. Shaw & Co. (an investment firm), Glaxo-Wellcome (pharmaceuticals, now Glaxo-SmithKline), IBM and... Monsanto.[34]

The panel was chaired by Peter Raven. Raven was a nationally known botanist, the Director of the famous Missouri Botanical Gardens and a professor at Washington University in St. Louis, but it was undoubtedly his ties to Monsanto that gained him his esteemed position on the panel. As reported by journalist Andrew Cockburn, Monsanto and Raven enjoyed a close relationship that included large donations from Monsanto to the Missouri Botanical Garden. In kind, Raven lent his academic credibility, national reputation, and extensive network to help sell the public on the idea of genetically modified crops, which were then a recent development[35] (having first been planted commercially in the US in 1996[36]).

Then and now, Monsanto produces GMO crops that are "Round-Up resistant," which means they are not harmed by application of the herbicide glyphosate, which Monsanto also manufactures. (No GMO crop to date has been developed for higher yields per se.) As the planting of GMO crops has become more widespread, so has the use of glyphosate and its negative affects on the environment, including steep declines in the populations of the Monarch butterfly, whose host plant has been especially hard hit by the notorious toxin.[37]

In March 1998, the panel issued its report, "Teaming with Life: Investing in Science to Understand and Use America's Living Capital." The political message is clear in the first lines: "Over the last few decades, a new paradigm

has emerged: Improving and protecting our environ-ment is compatible with growing the Nation's economy." As any serious environmentalist knows, that's a statement of fantasy, not fact. The resources of the planet are finite, while the appetites of an expanding economy are unquenchable. The two are incompatible. Raven, of all people, should know that, having collaborated with Paul Ehrlich, author of "The Population Bomb," in the 60's.[38]

There's a lot of talk in "Teaming with Life" about "sustainable management," "natural capital," "biological resources," "economic incentives to conserve" and the "'next generation' national biological information infrastructure." "Ecosystem services" are mentioned no less than 35 times. It's doublespeak that has nothing to do with true conservation and everything to do with corporate bottom-lines, especially of the industries represented on the panel. Monsanto's favorite, genetic research, is found under nearly every subject heading in the report. The second recommendation made in the Executive Summary is to "search out America's biological species, their genetic properties, and their interrelationship."[39] For Monsanto, the value of biodiversity is that "with genetic engineering, helpful traits in these wild relatives may be transferred to the crop species."[40]

Monsanto's favorite, genetic research, is found under nearly every subject heading

Mentions of invasive species are sprinkled throughout the report, including the incredible claim that "at present, approximately one-fourth of annual US agricultural GNP is lost to invasive species and the cost of controlling them"[41] We were unable to confirm or locate this figure anywhere else.

The report recommended "a mechanism to coordinate resources and initiatives to evaluate, control and mitigate the impact of invasive species should be developed across Federal agencies."[42]

That very outcome came to fruition a little less than a year later with Clinton's executive order forming the NISC. In hindsight, we can recognize this action as yet another example of the neo-liberalism that guided Clinton's governance: the state's role as regulator was exchanged for that of enabler, and instead of the commons being protected, it was divvied up amongst the highest bidders. But with all the right-sounding language, so most people were sold on it.

Cockburn notes that "among the founding members of the council's advisory committee was Nelroy E. Jackson, a product-development manager and weed scientist for Monsanto who had helped to develop Roundup formulations specifically for 'habitat-restoration markets'—that is, for eradicating invasives."[43]

We respectfully suggest that you can have a process of legitimate scientific review and recommendation or you can have a process involving Monsanto every step of the way, but that you cannot have both.

Every political process involves compromise. In this case the compromise was between, on one hand, powerful industries with fat purses, and on the other, academic institutions that seek research funding. So, one unstated but understood element for all participants was financial interest of some kind. Their work cannot be understood clearly without taking that element into account. There is no moral judgment in this observation; it's simply descriptive.

Why does it matter? Because entities like NISC play a significant role in setting both the tone of the discussion and the parameters of action for the issues they cover. That's the purpose of such public/private partnerships. The "stakeholders" agree what's important and that's how policy is dictated and

how funds are disbursed. The messaging trickles down through related institutions and reaches the level of the individual with the resonance of distant but respected authority.

Fast-forward to 2016.

The NISC has now existed for seventeen years. Hundreds of government agencies at every level, from city, county and state to federal, are targeting invasive plants in their jurisdictions, taking their cues from above. Glyphosate has become a favorite eradication method across the nation. In 2014, "the federal government spent more than $2 billion to fight the alien invasion, up to half of which was budgeted for glyphosate and other poisons."[44] Budgets increased in both 2015 and 2016.[45]

Monsanto's goal: "altering the genomes of entire populations of wild organisms."

NISC's "Management Plan, 2016-2018," approved on July 11, 2016 contains a few interesting nuggets:

• A recommendation to use free trade agreements such as the Trans Pacific Partnership to work with other nations towards "enhancing efforts to assess and address the risks and adverse impacts of invasive species."[46] Here's a way to expand markets globally.

• A warning! "The United States currently lacks the comprehensive authority, or clarity of authority, necessary to effectively prevent, eradicate, and control invasive species that impact the human-built environment ("infrastructure")... and that cause or transmit wildlife disease."[47] Thus are identified two more areas for expanding commercial markets.

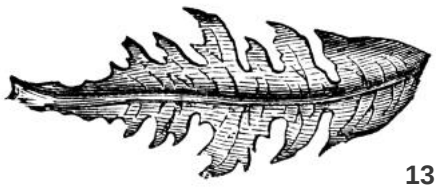
• By far the most malevolent item, we felt: "By altering the genomes of entire populations of wild organisms, genetic editing may improve capacities to prevent, eradicate, and/or control populations of invasive species currently thought to be an indefinite problem."[48]

The issue of invasives has been receiving increasing attention from the power structure since 1999. Why is that? Let's assume the issues as stated are real and have worsened since then; even if that's the case, it still doesn't necessarily answer the question.

The climate crisis has increased tremendously since 1999 but there has been no concomitant ramping up of resources to address it, and it's a bigger one: literally existential for the human race. Other crises have also worsened: over drinking water, affordable housing, and access to healthy food, for example, and none have merited an executive-ordered brain trust. No, the rising level of attention for invasives in officialdom is not about science or ecology or need; it's simply reflective of the growing opportunities for profit by certain powerful players, most prominently herbicide manufacturers.

If there is a real invasion crisis, they're not looking to solve it, just like no arms manufacturer wants to see world peace. So if you believe that there is a legitimate invasion crisis—and that's a subject that deserves serious treatment—then you need to look beyond the conventional wisdom as filtered down to us from above. If we want facts, we need to start from the ground up. And lucky for us, that's where we all happen to be, isn't it?

The two of us daily mourn the hurts in the world that need healing. Also, it's not that we don't believe in invasions. We know that a very real one happened in 1492 and that forces of domination have occupied the continent since then. We agree that something doesn't belong here. That's where we'd like to focus our attention.



A pointless, brutal tragedy is currently taking place in the Great Basin of the US American west: the destruction of native Pinyon-Juniper forests. Thousands of acres of trees are being clear-cut, shredded and mulched. Inevitably, collateral damage is being suffered by the vibrant community of flora and fauna these forests host.

These heinous acts are being committed in part under the auspices of controlling so-called "native invasives."

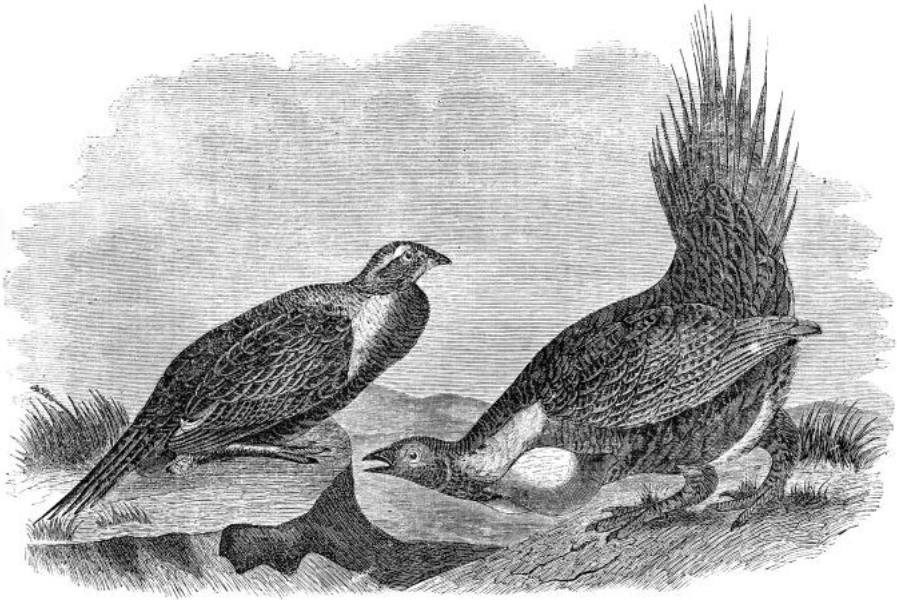
Pinyon-Juniper Tragedy

As noted by biologist Katie Fite, this campaign against Pinyon-Juniper forests is the third wave in a series of massive assaults in US history. The first happened in the second half of the 19th Century when "trees were clearcut over vast areas—even their roots dug out—to produce charcoal to process gold and silver ore." The purpose of the second wave, after WWII, was to clear land for ranchers. Trees were cut, chained, sprayed and burned on a large-scale basis until the 90's.[49] Three million acres were converted to pasture between 1950 and 1964, and more than a third of a million acres between 1960 and 1972, in Utah and Nevada alone.[50]

The current wave is being spearheaded by the BLM and the Forest Service and once again for the benefit of ranchers, though that's not how it's being presented. Instead, the ostensible reasons are to improve Sage-Grouse habitat, control wildfires, and halt the spread of so-called "native invasive" species, a new label being pinned on the Pinyon and Juniper trees.[51,52]

We hasten to note that the "native invasive" concept does not enjoy consensus in the invasion biology community, at least not yet.[53] But for the Pinyon-Juniper forests being decimated right now under that rubric, that's no consolation.

Not that the word, "invasive," has to be spoken for its damning specter to be invoked. In project descriptions, the BLM talks about the need to "restore natural site conditions" and remove "encroaching pinyon-juniper trees."[54] This isn't the letter, but it's the



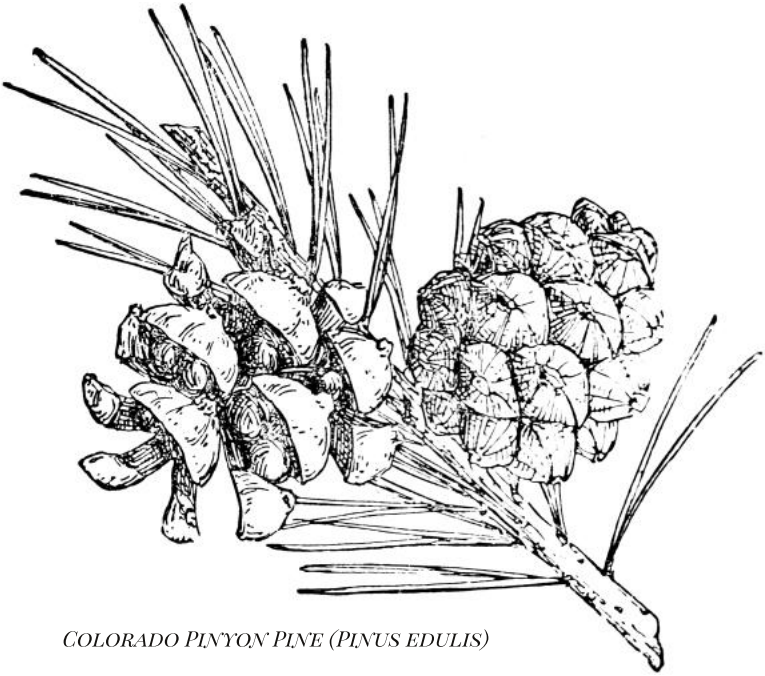
GREATER SAGEGROUSE (CENTROCERCUS UROPHASIANUS)

spirit. These are fighting words and they spur on the eradication of an enemy without any further justification. The language paves the way. Not for the first time in history, the popularity of an inciting ideology is giving cover to a criminal act.

How can the Pinyon tree be "encroaching" when it has lived in the area for so long? The Single-Needled Pinyon (Pinus monophylla), which is the dominant Pinyon species in Nevada and to the west, originated around 20 million years ago as a mutation of the Colorado Pinyon (Pinus edulis).[55] That makes P. monophylla 100 times older than Homo sapiens, which only goes back 200,000 years. Considering the age difference, do we have any right at all to question the wisdom of this elder? We're serious. Maybe we ought to get off of their lawn.

P. edulis, which is even older, is currently found in Colorado, Utah, Arizona and New Mexico, but the ranges of both species have experienced expansions and contractions as climatic conditions have changed. For example, since the end of the last glaciation period, 11,700 years ago, they have been moving steadily northwards.[56] "Historic range" has been fluid over time but aren't the locals just allowed to amble where they wish?

The BLM "treatments" in the Great Basin, both proposed and ongoing, include "lop and drop," mastication, herbicides and chaining. Chaining involves attaching a huge anchor chain from a battleship between two tractors and dragging it along the desert



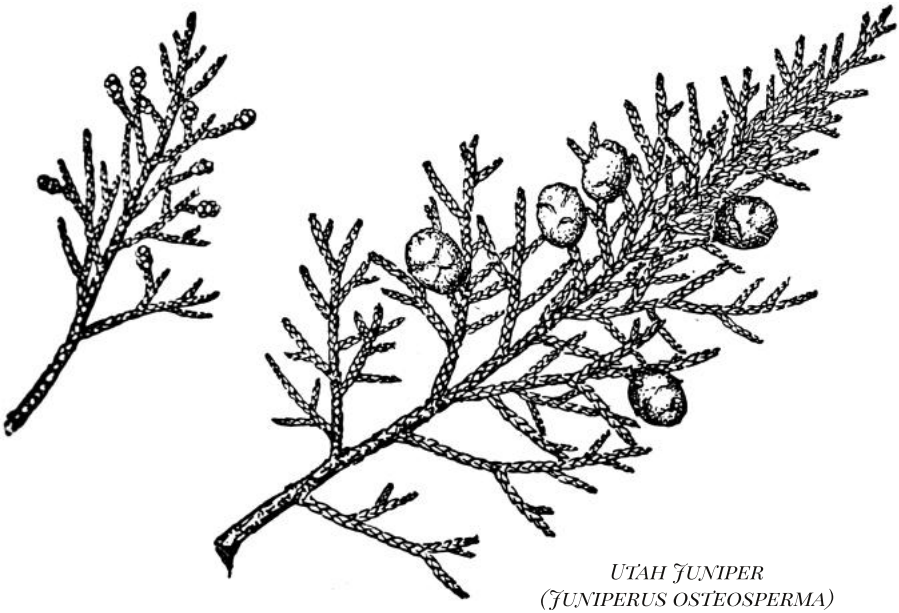
COLORADO PINYON PINE (PINUS EDULIS)

floor, ripping trees and bushes from the ground, wrecking delicate soil crusts, and killing or injuring countless other creatures in their dens, nests and hideouts. The extent of the damage is unknown, as it is not being adequately tracked.[57]

These "treatments" are presented as a viable option for creating Sage-Grouse habitat, rather than, say, removing cattle from degraded habitat so it can recover or not opening up current, more intact habitat for fracking. Other bogus reasons for "treatment" include decreasing erosion (whatever that means), and increasing stream flow for water users (who are already taking more than can be sustained).

Will Falk, an eloquently spoken friend of Pinyon-Juniper forests, summed it up well: "The Pinyon-Juniper encroachment theory is a product of settler colonialism's historical amnesia. One of the products of the white supremacy brought to the Great Basin by European settlers is a selective memory that ignores guilt-inducing facts of ecological destruction wrought on the Great Basin by European mining activities."[58]

Amnesia is right. The proponents of "encroachment" projects repeatedly refer to historical ranges of Pinyon-Juniper woodlands from the early 20th Century, a reference date conveniently placed after the massive clear-cutting of the late 19th Century, which significantly impacted these ancient forests and reduced their ranges locally.



UTAH JUNIPER
(JUNIPERUS OSTEOSPERMA)

A visit to the old Ward charcoal ovens on state park land outside Ely, Nevada, provide a great opportunity to confirm evidence of the former clear-cutting, as Nicole saw for herself on a 2017 visit. This is only one of many operations where thriving forests were converted into fuel for smelting ore. Tourist signs boast of how during their three years of operation (1876-1879), all the trees were cleared for thirty miles in every direction. As the trees of forest have returned to their recently vacated home, with the help of birds and other creatures, they have been falsely described as "encroaching." The foothills in that valley have been subjected to removal treatment well within thirty miles of the ovens.

About fifty miles west of Ely is the town of Eureka, where "by 1878 the woodland was nowhere closer than fifty miles."[59] This history repeats itself, about every 50 miles, all across the state along Highway 50, west to Virginia City. Throughout the entire area, Pinyon-Juniper forests have been recovering their native range, but certain invasive humans can't leave them alone.

Such humans who argue for this "restoration" cite research that lacks real data, but no matter; they rely heavily on anxiety inducing language, and that'll do the trick. This is a recurring theme that echoes through invasive biology. A fearful claim of invasion is the beginning bias of research, so results are reported as such, that bias is fed to the public and the restoration industry is fueled by public tax dollars and grants to answer the destructive cry. Take this

PINYON JAY
(GYMNORHINUS CYANOCEPHALUS)

sentence: "Most ecologists and resource managers agree that juniper has become a deleterious native invasive plant that threatens other vegetation ecosystems, such as grasslands, through a steady encroachment and ultimate domination."[60] "Deleterious," "threatens," "encroachment," "domination": Those words describe someone, for sure, but it's not Juniper.

We must point out that an indispensable party is left out of nearly all discussions of the Pinyon-Juniper forests and that's the Native Americans. Pinyons were central to the lifeways of many tribes including the Shoshone, Paiute, Goshute, Cahuilla, Havasupai, Hopi and Kawaiisu, among others, who enjoyed the nuts as a staple food in a variety of delicious and healthy preparations; availed of the pitch and resin medicinally for a multitude of ailments; and utilized the needles, bark and wood for crafts and tools. Juniper berries also provided a source of sustenance for different tribes, though they were more sparingly employed.[61] The campaign to remove these

DESERT COTTONTAIL (SYLVILAGUS AUDUBONII)

trees in the 19th Century didn't just provide fuel for industry. Like the annihilation of the buffalo in the Midwest at the same time, it served to sever the Native Americans from their land by slaughtering their sources of sustenance.[62]

In this way, the current assault on Pinyon-Juniper forests is just the latest chapter of the Indian Wars, which never ended.

So yes, let's take this word—"invasive"—and let's stick it where it belongs. But that's not on plants who have lived here for tens of millions of years—or on any plant at all, for that matter, who are all merely acting in their own nature, regardless of where they end up, no fault of their own. No, there's one place and one place only where that word belongs and that's on the savage culture of death that arrived here from the "Old World" in 1492 and is still viscously occupying this land.

We who benefit from this reality need to own up to it and stop dishing out the blame where it doesn't belong. As a start.

FUNNY MATH

Calls-to-action often rely on claims of damage, past or potential. As a particular call is repeated, these claims can be inflated, conflated, jumbled, mistaken or otherwise misconstrued. The further one gets from the source, the more likely that the facts have been lost. It's like that game, telephone, where a message passed around a circle of people in a whisper is all mixed up by the time it completes a circuit.

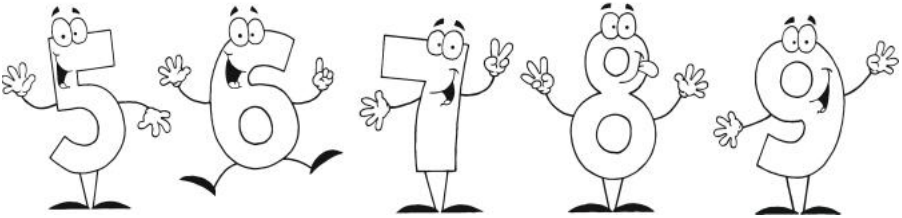
Unfortunately, scientific literature is not immune from this syndrome. A study will be cited by subsequent studies that use the preliminary—and often particular—conclusions of the original to back up new conclusions, often increasingly generalized. Statements are quoted out of context, paraphrased further out of context, and reiterated even further out of context until "many authors feel comfortable in reporting it without citing any source at all."[63] Eventually, such statements are simply accepted as fact, especially by non-scientists like journalists, policy makers, and non-profit grant seekers.

Therefore, investigating the original source of a frequently made claim—of any kind, be it scientific, political or historical—is arguably mandatory. After following the thread back to its source, and understanding the original findings or data for what they are, one can decide whether the current call-to-action's prescribed course is appropriate or practical or pencils out financially.

Wittingly or not, the field of invasion biology has played the telephone game with some of its major claims. We will look at just two here: 1) The estimated financial costs of invasives and 2) the level of threat to endangered species by invasive species as compared to other threats.

First, it is frequently claimed that invasives cost the global economy $1.4 trillion annually with $137 billion of that footed by the U.S. The original source of this figure is a paper by David Pimentel, et al., in 2001, "Economic and environmental threats of alien plant, animal, and microbe invasions."[64] Many, if not most claims about the monetary costs of invasives, ultimately refer back to this source. Let's take a look at some of his claims and methodologies.

First off, how is Pimentel defining invasive species? He uses several terms interchangeably: "alien species," "invading alien species," "introduced," "non-native" and "non-indigenous." Is he considering all



non-native (or whatever) species "invasive"? Because that's certainly not the consensus within invasion biology or elsewhere.

Regardless, according to a table of "alien species," the US hosts 25,000 plants, 308 animals, 4500 arthropods and 20,000 microbes that are alien. Note that microbes are 2/3 of the total. For people who associate "invasives" with Zebra Mussels, Kudzu and the like—as we would venture to guess most people do—that might seem a little strange.

Table 2 shows "Economic losses to introduced pests in crops, pastures, and forests in the United States, United Kingdom, Australia, South Africa, India, and Brazil" and racks up a total $228.22 billion annually. Are any of these designations made up of native plants? With "crops," decidedly "no," as Pimentel makes clear (see below). Though the term "pasture" is "primarily used for the production of adapted, domesticated forage plants for livestock" [our emphasis] as opposed to "rangeland" which hosts "native vegetation,"[65] Pimentel seems to be including $5 billion in the cost of controlling weeds on "rangeland" in the figure, so we will say, "yes," this category includes native species. The final category, "forests," are highly likely to be populated with native tree species, though "managed" ones might be replanted as monocrops of such. Even so, the total losses to pastures and forests put together add up to merely 5%.

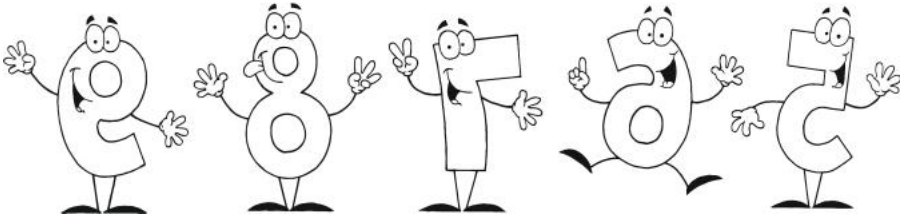
So let's be clear what that 95% ($216.50 billion) is measuring: the cost of damage by one set of introduced species ("weeds") to another set of introduced species (agricultural crops), which are themselves a major—if not the leading—cause in the decline of native species. You want to talk about habitat loss? How about the one fifth of the lower 48 US states devoted to field crops? Or the 40% (overlapping with the former) used for animal agriculture? But to Pimentel (and every author who cites these numbers), such grievous truths are irrelevant.

Pimentel is not ignorant of the "alien" nature of agricultural species, either. He states: "Nearly all crop and livestock species are non-indigenous. These alien crops (e.g. corn and wheat) and livestock (e.g. cattle and poultry) are vital to maintaining world agriculture and the food system. However, these benefits do not diminish the enormous negative impacts of other non-indigenous species on agricultural and other managed and natural ecosystems."

Let's not get romantic about the "world agriculture and the food system" either. Pimentel is referring to an industrial sector first and foremost, not to Old MacDonald growing juicy tomatoes and raising happy pigs on a family farm or even to Jose and Maria toiling in the citrus orchards, lettuce fields and vineyards, which is more likely. No, he means Cargill, Conagra, Archer Daniels Midland, Tyson and other corporate giants, who don't give a damn about our native flowers, birds or butterflies.

Moving on to table 3, "Environmental losses to introduced pests," Pimentel ascribes damages by the following agents: Mammals (Rats & "Other"), Birds, Reptiles & Amphibians, Fishes, Arthropods, Mollusks, Livestock Diseases and Human Diseases. The total damages for the US are $58.299 billion. Since this table is titled, "environmental losses," you might assume we are now looking exclusively at harms to native species rather than crops (to which the previous table was dedicated, after all). But you would be wrong.

The single largest item is "Rats" at $19 billion. Is this Rats gobbling up native bird eggs, devouring native flower seeds or decimating native insect populations? Nope. It's rats "on farms, in industries, and in homes."



How does arrive at $19 billion? First, he calculates the total rat population of the US by adding two numbers: the ratio of rats to chickens—1 to 5—and of rats to people ("in homes and related areas [whatever those are]")–1 to 1. Then:

"If we assume, conservatively, that each adult rat consumes and/or destroys stored grains (Chopra 1992; Ahmed et al. 1995) and other materials valued at $15/yr, then the total cost of destruction by introduced rats in the United States is more than $19 billion per year. In addition, rats cause fires by gnawing electric wires, pollute foodstuffs, and act as vectors of several diseases, including salmonellosis and leptospirosis, and, to a lesser degree, plague and murine typhus (Richards 1989). ***They also prey on some native invertebrate and vertebrate species like birds and bird eggs*** *(Amarasekare 1993)"* [our emphasis].

The damage to native species is apparently too small to bother estimating, as he offers no number for it. Is this paper about ecological damage or not?

The next highest number in table 2 is $17 billion, which Pimentel attributes to the domestic cat, both homed and feral. He estimates (in a previous paper[66]) that cats kill an astonishing 465 million birds in the United States annually. He cites two papers in extrapolating this number. The first estimates the number of birds killed by feral cats in the states of Wisconsin and Virginia.[67] The second, "The Population Origins and Expansion of Feral Cats in Australia,"[68] which we reviewed, is focused on the genetics of the domestic cat on that continent and mentions diet only peripherally. The figure $17 billion is based on a per bird cost of $30. Explains Pimentel: "This cost per bird is based on the literature that reports that a bird watcher spends $0.40 per bird observed, a hunter spends $216 per bird shot, and specialists spend $800 per bird reared for release." Uh, thanks for clearing that up?

The third highest cause of environmental loss in Pimentel's report is disease, of both livestock and humans, with $15.50 billion in damages.

Introduced plant species come in a distant ninth in his ranking, with $148 million in damages. This is made up of "US$ 45 million per year in purple loosestrife control plus US$ 100 million per year in aquatic weed control." Which leaves a whopping $3 million per year in "environmental losses" due to all the other dreaded invasive plant villains like Kudzu, Tamarisk, Garlic Mustard, etc., which are regularly presented as the banes of civilization. Has anyone making the case against invasive plants ever cited this particular statistic?

If this paper was a boat, you wouldn't dare get into it, it's so full of leaks. Yet, it remains a popular "go to" for invasion biologists.

The second major claim we will address is that invasives are the "second greatest threat to endangered species worldwide." This claim was originally made by Wilcove, et al. in their 1998 paper, "Quantifying Threats to Imperiled Species in the United States." Over the following decade this claim was cited over 700 times, and quickly became accepted as fact, though "article of faith" is a more accurate characterization, as we will show.

In their defense, the authors of the original paper were upfront about limitations to their data set. To wit:

"We emphasize at the outset that there are some important limitations to the data we used. The attribution of a specific threat to a species is usually based on the judgment of an expert source, such as a USFWS employee who prepares a listing notice or a state Fish and Game employee

who monitors endangered species in a given region. Their evaluation of the threats facing that species ***may not be based on experimental evidence or even on quantitative data****. Indeed,* ***such data often do not exist****. With respect to species listed under the ESA, Easter-Pilcher (1996) has shown that* ***many listing notices lack important biological information****, including data on past and possible future impacts of habitat destruction, pesticides, and alien species. Depending on the species in question, the absence of information may reflect a lack of data, an oversight, or a determination by USFWS that a particular threat is not harming the species.* ***The extent to which such limitations on the data influence our results is unknown****"*[69] [our emphasis].

And later:

"Again, we note some caveats with respect to the data in this phase of the analysis. Species added to the endangered list prior to 1980 (238 species) tended to have fewer threats delineated in the listing notices than species listed in later years... We do not know how this pattern may have influenced our results. Also, as noted in our coarse-scale analysis, ***assessments of the threats to individual species are often based on the subjective opinions of knowledgeable individuals, rather than experimental evidence or quantitative data****"*[70] [our emphasis].

In short, don't bet the farm on these numbers. But those who repeated the dire "second greatest threat" ranking either ignored these qualifications or (more likely) didn't read the paper past the abstract or (even more likely in the case of journalists and other non-scientists) at all.

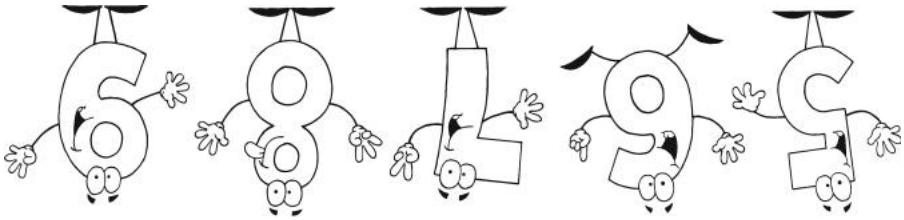
But that's not the biggest issue with this paper's most publicized claim. The main factor that should have limited the use of this citation as a global reference was how the numbers were skewed upwards by the inclusion of Hawai'i with the continental US. The ecology of islands is "vastly different"[71] from the ecology of continents, especially with respect to introduced species,[72] and, as would be expected, the number of species under threat from invasives was much higher in Hawai'i than on the mainland.

Again, the authors were forthcoming about these discrepancies. They devoted one table and two figures to laying out and illustrating them. We summarize the important differences in the table below.

Note that the percentage of native plant species in the continental US threatened by alien species falls from 57% to 30% when data from Hawai'i is removed. That's a difference of nearly 50%, which is surely "statistically significant," as they say.

	Aggregate	Hawai'i	Cont'l US
Habitat degradation & loss	81%	66%	90%
Alien species	57%	99%	30%
Pollution	7%	0%	12%
Overexploitation	10%	6%	13%
Disease	1%	0%	1%

Any given plant species can face multiple threats, which is why the numbers in a column add up to more than 100.



But this isn't the end of the story. The authors broke down "habitat degradation and loss" into eleven categories and reanalyzed a subset of their aggregate data (species added to the endangered species list since January 1, 1996, which comprises 723 rather than 1055 plants). Unfortunately, they did not provide the new "alien species" percentage for this subset, or break out Hawai'i, but four of the categories exceeded 30% for plants: development 36%, agriculture 33%, grazing 33%, and outdoor recreation 33%.

In other words, it is possible that for native plant species in the continental US, alien species are the fifth greatest threat, not the second, according to their (admittedly limited) data.

In a paper criticizing invasion biology that reviewed this paper, noted by ecologist Mark A. Davis wrote: "when the paper was written there was no evidence that a single native North American plant species had been driven to extinction, or even extirpated within a single US state, by competition from an introduced plant species."[73]

As a side note, when the Wilcove paper was published in 1998, the issue of climate change as a threat to native species was still emerging. Showing some respectable prescience, the authors added an entire section covering the issue as discussed by other researchers. They stated: "Although climate change was not listed as a current threat to any species in our databases, it is almost certain to become one in the foreseeable future due to increasing concentrations of greenhouse gases from fossil-fuel use, land-use changes, and agriculture."

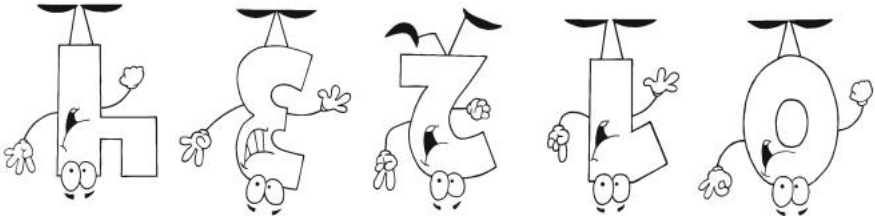
Given the increasing threats of climate change, and the shortcomings in data and aggregation detailed above, we respectfully submit that the Wilcove paper should no longer be cited without qualification in reference to the topic of invasive species.

In his book, "The New Wild: Why Invasive Species Will be Nature's Salvation," journalist Fred Pearce followed the trail of other bold claims that demonize non-native species. On fact-checking frequently repeated claims, he stated that "there is a threadbare laxness in the use of statistics by many invasion biologists. Almost wherever I pursued a key claim, the trail fizzled out in obfuscation, false citations, unverified judgment calls, and absurd leaps from the specific to the general and the local to the global."[74]

We suspect that most proponents of invasion biology would prefer a higher burden of proof for themselves before, say, being imprisoned or put on death row. (Unfortunately, many people in the US do suffer this fate, more often than not due to discrimination based on their perceived otherness in the society.[75] As a side note, journalist Andrew Cockburn noted that Pimentel's "dislike of aliens apparently extends to the human variety, as evidenced by his public opposition to both legal and illegal immigration."[76])

The point here is not to pick on Pimentel or Wilcove or et al. (though other writers have been happy to do so) but rather to point out that numbers in papers like these aren't as "black and white" as they sound when they're pulled out and paraded around on their own.

We are not saying that the numbers are meaningless. They're based on something, after all. Just not actual counts of solid objects in the real world. But that's how statistics work, and there's nothing new about that. As has been said for over a century: "There are three kinds of lies: lies, damned lies, and statistics."[77] But most people don't know that about statistics, so they hear "$1.4 trillion" and assume that's a



genuine total, as in, the added-up sum of other concrete numbers. But it's not.

For example, let's look more closely at that $45 million for Purple Loosestrife "control" (eradication) in Pimentel's paper. In a table of "losses," does this count? Wouldn't many people consider control a "cost?" Put it this way: if you go out for a night on the town and someone steals $45 from you, or it slips through a hole in your pocket, that's a loss. But if you spend it in a bar, that's a cost. In the first instance, the money is gone against your wishes, but in the second you willingly gave it up. And if the latter is the case—that it all went to beer and smokes—would you complain to your roommates about the $45 you "lost?" If you did, we bet they would not express much sympathy for you as they would for a mugging. Just saying.

But that's only common sense and the branch of mathematics[78] known as statistics operates in a different world where it is indeed standard practice for a cost to be counted as a loss, as Pimentel did.[79] It is totally allowable to add a number based on a projection (lower yield from weeds) with a number copied from a receipt (cost of herbicides); that is, to treat a guess and an actual outlay as equivalent.

If that's how statistics operates, fine. Good to know. But again, how many people know that? The impressions these numbers create are real enough, and more so are the subsequent actions such as the use of herbicides. We reckon that very few scientific papers count as a loss the number of native plants killed as collateral damage when glyphosate is sprayed.

Monsanto, a manufacturer of glyphosate, is—like most giant corporate entities—well-practiced at manipulating statistics for their own benefit and are happy to take advantage of those who are less savvy, such as gullible elected officials or over-eager conservation officers, to say nothing of the general public.

We would guess that if anyone from the biotech industry has ever checked Pimentel's work, it's just to make sure he's not under-estimating. We have a feeling they've never bothered, though, since his attitude is exactly what they want.

And what about the 788 papers that cite Pimentel's work? Or the 700+ that refer to Wilcove's? Should scientific researchers know better? Is it enough for them to just skim the abstract and the conclusion? Or should they be digging deeper? Following citations to confirm that they check out? Adding up numbers to see that the math is right? (It's not, by the way, in the grand total on the far bottom right in Pimentel's table 2, and is off by nearly a factor of 10.)

Are some authors just copying-and-pasting a familiar citation just because it's familiar? Because dropping that name shows what club they're in? Because it'll help in the next round of funding? Scientists are like everyone else and feel the same social pressures to conform, the same fears of alienation. Most of them don't want to work too hard or stick their neck out too far when it comes right down to it. So maybe we shouldn't expect too much of them?

Also, many scientists are on corporate payrolls, directly and indirectly, and their words are not to be taken at face value. For three decades, Monsanto was able to conceal the dangers of glyphosate, with the assistance of compromised scientific researchers being essential to that effort.[80,81,82] Now their false narrative is officially falling apart thanks to a high profile court case.[83] But, vitally, the entire time they were spreading lies, other people toiled to bring the real facts to light. Their work and dedication is now being vindicated. We'd like to think that, in the end, "the truth will out."

SHOOTING THE MESSENGERS

How Saltcedar and Russian Olive are unfairly blamed for the wasteful water practices of humans

Popular ideas are not always factual ideas. When the subject is a particular "invasive" plant species, common assumptions about its undesirable impacts are not always scientifically documented or even true. Add to this an inherent bias in the field of invasion biology for interpreting nearly all effects of non-native plants as detrimental without considering the possibility of positive outcomes and you're sure to get villains nearly every time.[84]

Let's look at two well-known examples of so-called "invasive" plants that are under the gun: Tamarisk, aka Saltcedar (Tamarix spp.) and Russian Olive, aka Oleaster (Elaeagnus angustifolia). In the western United States, these two trees are now the third and fourth most frequently occurring woody riparian plants, and the second and fifth most abundant species along rivers.[85] To eradicate them would entail destroying a significant amount of healthy vegetation (with no little amount of collateral damage to other flora) and would incur a hefty cost. Congress authorized $80 million for Saltcedar removal between 2005 and 2009, which included herbicide, but that is pennies compared to what would be needed for everything.[86] So the case for removal needs to be strong.

But the case is not strong. The main claims made against both species are that they a) push out native flora, b) monopolize groundwater, and c) don't provide for native fauna. Saltcedar is additionally accused of increasing the salinity of its immediate environment. Yet these claims have never been proven and plenty of evidence to the contrary has been produced. Juliet Stromberg and Matthew Chew, who are faculty at the School of Life Sciences at Arizona State University, have been debunking these myths, and they say that scientists have been participating in "a rationalized scapegoating of Tamarix as an agent of change because of its ability to thrive in anthropogenic habitats."[87] Even less researched, Russian Olive has also been used as a scapegoat. For example, the USDA's National Resource Conservation Service (NRCS) makes the contradictory claim that that Russian Olive "has been especially invasive in wet-saline riparian areas" even though the "wet-saline niche" it inhabits is inhospitable for many native woody species.[88] In the case of both these tree species, on-the-ground evidence shows they are not displacing native riparian trees, but are filling in after the native speces decline due to changing environmental ciircumstances, namely, less water and saltier soils from irrigation and dams.

The dominator myth

First, on the assertion that Saltcedar and Russian Olive are pushing out native flora, namely Willow (Salix sp.) and Cottonwood (Populus sp.), numerous studies show that the newcomers have been filling in where the natives were already receding or gone[89] and that "anthropogenic alteration of stream-flow regimes is a key driver of compositional shifts."[90] This includes the restriction of seasonal floods due to dams and associated water table changes.

The seeds of Saltcedar germinate far better in drier soils than those of Willow and Cottonwood, which require the wetter circumstances provided by seasonal flood events typical of free flowing rivers. Native tree seeds were found to germinate and grow right up through Saltcedar thickets after dam managers released more water into the Lower Colorado River, prompting ecologist Edward Glenn to investigate the claims against Saltcedar.[91] When a manager at the Bosque del Apache National Wildlife Refuge opened a floodgate with the timing of Cottonwood seeding, he discovered that the native seedlings emerged first, showing that the dominance of Saltcedar seedlings is "only a symptom of river systems that had been robbed of their seasonal rhythms."[92] Cottonwood seedling establishment requires both the moisture and the bare soil provided by floods, with their sediment churning actions. Russian Olive has been found to germinate well amidst thick herbaceous vegetation of undisturbed riparian areas that lack the disruptive action of seasonal floods. These are the very areas where Cottonwood and Willow find establishment difficult.

The problem of less water has not been caused by Saltcedar or Russian Olive (or any other tree for that matter). It is human greed for water beyond what is needed which has created environments that are better suited to these non-native trees than the natives.

It's worth noting that the origins of Saltcedar's reputation as a water-monopolizer lay with extraction industries who sought to claim more water rights for "beneficial" use—that is, for their operations—and who devised a scheme to wrangle it from veg-

SALTCEDAR, AKA TAMARISK (TAMARIX SP.)

etation, who were "non-beneficial users" with no legal rights to the water.

In the 1930s, the Phelps Dodge Mining Corporation (PDC) in Eastern Arizona was desperate for water. They had been gearing up to pursue open-pit mining at Morenci copper mine but lacked adequate water to do so. Safford valley water rights were already fully allocated to other users. In 1939, the PDC was "in prime position to supply copper demands for the looming war" after Pearl Harbor. They just needed the water. So the U.S. federal War Department Engineer Office and Bureau of Indian Affairs financed a water resource inventory along the upper Gila River. This was conducted by the USGS staff. The PDC mining moguls had already been conducting the removal of trees along the Gila River in order to claim appropriable rights to the water thereby "saved."[93]

WILLOW (SALIX SP.)

"Phreatophytes" was the newly coined term assigned to Tamarisk and eighteen other valley dwelling trees who supposedly drew heavily on groundwater resources. This was deemed a non-beneficial use of water. But it was not until the wartime cultural climate that Tamarisk was singled out as a target.

In 1950, the inventory results were published in the USGS Water Supply Paper, "Use of Water by Bottom-Land Vegetation in Lower Safford Valley Arizona." Tamarisk was declared to be a uniquely threatening alien, which "thrived and spread at the expense of nearly all the native plant life." Accused of growing into "a dense jungle-like thicket that is difficult to penetrate," the trees were assaulted by surveyors with a tool from the recent war: the flame-thrower, the iconic weapon of the "island-hopping" Pacific campaign. With no scientific backing, Saltcedar rose to the ranks of a national security threat by "standing in the way of mine expansion."[94]

The miners' tall tale, despite its basis in "a reputation" not facts, grew legs and is still walking around today. "Conservationists" are among those who still endlessly repeat the spurious claim. And despite evidence to the contrary that has since emerged such as: "After an extensive eradication of tamarisk along the Pecos River in Texas over five years from 1999, Charles Hart of Texas A&M University could find no evidence of any greater flow in the river."[95]

The results of a decade long investigation along three rivers in the Southwestern U.S. put the lie to the Saltcedar water myth again. The study found that there was no significant difference in the water usage between three vegetation communities regardless of the native/non-native make-up of the areas. The study chose three sites: the Lower Colorado River, consisting of 90% Saltcedar vegetation cover; the Middle Rio Grande in New Mexico, with an even vegetation cover of Saltcedar and native trees; and the San Pedro River, considered the last undammed river of the Southwest, with only a few scattered stands of Saltcedar. Measurements of transpiration (the gaseous moisture mix that trees exhale) were taken using

sensitive flux towers designed for climate change studies. All three vegetation covers were found to transpire an average of one meter of moisture per year into the atmosphere.[96] Thus, the amount of water that Saltcedar drinks has been shown to be on par with her native comrades, and—in places where sufficient moisture remains for the native species to survive—one can find cohabitation among natives and newcomers alike.[97]

Nevertheless, history regresses and repeats. During a more recent period of drought, the discredited idea of salvaging water from wasteful vegetation was back on the table. On October 11th, 2006, President George W. Bush signed HR 2720, the "Salt Cedar and Russian Olive Control Demonstration Act" which this time around also leaned on the crutch of "invasive species" to appeal to modern sentiments,[98] facts be damned.

WILLOW (SALIX SP.)

The lack of quantitative evidence has yet to make much of a dent in the plant's undeserved reputation, so we see things like this: "In summer 2001, an article about tamarisk in a major Colorado newspaper declared, 'It's a water-gulping, fire-feeding, habitat-ruining, salt-spreading monster.'"[99] Wow. As the old adage goes: "A lie can travel halfway around the world while the truth is putting on its shoes." And even farther, maybe, when motivated by money, whether that's mining profits or grant funding?

Removing the vegetation willing to grow in these conditions will not change the conditions themselves. The NRCS, while still advocating eradication, recognizes that the "decline of native cottonwood gallery forests and invasion by Russian Olive invasion are frequently associated with a change of the natural disturbance regime of riparian areas, frequently as a result of river regulation."[100] So even when it is known to not be the cause of disturbance, removal is the best thing to do? How perverse.

The soil salinization myth

The high permeability of soils in the western U.S. (i.e, their sandiness or gravelyness) make them highly susceptible to salinization through improper irrigation, which describes most irrigation practiced there. The syndrome is nothing new to agriculture, and the effect was observed in the Middle East long ago; writes Chellis Glendinning: "By 2000 BC, there were reports of 'earth turned white,' a clear reference to salinization."[101]

Dams also contribute to the salinity problem. Evaporation from the large surface area concentrates salts and agricultural runoff flows bring more. Additionally, with lower stream flows and fewer flood events, salts also concentrate in riparian soils, negatively affecting vegetation. The water being released downstream is reduced in flow with an elevated salinity load. Further, the loss of seasonal floods removes the

flushing effect that could reduce accumulated surface soil salinity caused by dry soils crusting over.

Improper irrigation water management can elevate the water table, which aggravates the accumulation of excess salts in the soil. This condition is not favorable for woody species that do not grow well in saturated (wet), saline soils (which, besides Cottonwood and most Willows, also includes Redosier Dogwood).[102] However, higher water tables are common where Russian Olive is found. She both tolerates this condition and remedies it. Saltcedar begins to appear along intermittent rivers with deep alluvial groundwater.[103] Increasing arid conditions and heavy water use upstream exacerbate this condition. Deeper taproots and a high salt tolerance lend adaptive benefits to this species.

At one time, the presence of saline soils where Saltcedar thrives was mistaken as an effect of the tree's presence, rather than one of the factors contributing to her ability to grow in such soils, where other plants could not. Russian Olive has also been found to tolerate elevated soil salinity levels. The NCRS points out the relative salt tolerances of these two species, stating that "Russian Olive gives way to saltcedar (Tamarix) on soils with elevated sodium levels."[104] These are soil salinity levels above the toleration of native riparian species such as Cottonwood and Willow. So, these "salt-of-the-earth" volunteers are "passengers, not drivers" of this condition. We are reminded of Lupine, a cosmopolitan genus of plants named Lupinus—"wolf"—by the Romans because they falsely believed the plant robbed the soil of fertility since it grows in waste places. In actuality, like many species in the Legume Family, Lupine improves its habitat by capturing ("fixing") nitrogen from the air and adding it to the soil.[105] Those who believe that contemporary people are so much smarter than ancient people might reflect on the lesson of Lupinus.

COTTONWOOD (POPULUS FREMONTII)

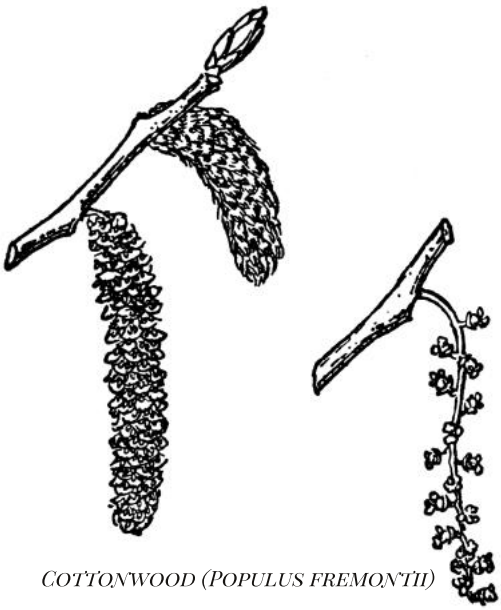
Intriguingly, data suggests that Saltcedar might be playing a similar role in overly salty places. Lower salinity levels have been measured where older stands of Saltcedar are established. If true, Saltcedar could ultimately be providing improved circumstances for native riparian species to re-vegetate.[106] The NRCS described how Russian Olive loses its competitive edge on non-saline hydric soils, where Cottonwood and certain Willows shade the Russian Olive, pointing to a different niche adaptation, not competition.[107] In fact, Russian Olive has been found to be effective in re-vegetating saline landscapes, reducing elevated groundwater tables and thus mitigating dryland salinization.[108] It seems these two species may actual be partnering in a desalinizing guild of succession: a symbiotic offering to their native friends to join them again later.

Dams and diversions created new water flow regimes and increased salinity loads. As Candace Hughes summed it up in Smithsonian magazine: "The real invasive

species are the dams diverting water for agriculture and saline water being put back in the rivers."[109] The increased evaporation from the surfaces of reservoirs concentrates the amount of salts in the water. Summertime floods no longer rinse the riverbanks, so salts accumulate in a pale crust. In contrast, natural floods still exist on the San Pedro, where saline soils—and Saltcedar trees—are rare.[110]

The bad neighbor myth

The aspect of ecological function is too often neglected when the "invasive species" flag is waved. That is, it is not asked whether the new species is interacting with neighboring flora and fauna in any positive ways. Or that these species are a part of natural succession given the environmental changes that have occurred. Russian Olive can also be recognized as a community type. In Montana, according to the "Classification and Management of Montana's Riparian and Wetland Sites," Russian Olive is considered to represent a seral stage of various habitat types, including: Green Ash/Common Chokecherry (Fraxinus pennsylvanica/Prunus virginiana), Boxelder Common Chokecherry (Acer negundo/Prunus virginiana), Ponderosa Pine/Redosier Dogwood (Pinus ponderosa/Cornus sericea) or Douglas-Fir/Redosier Dogwood (Pseudo-tsuga menziesii/Cornus sericea).[111]



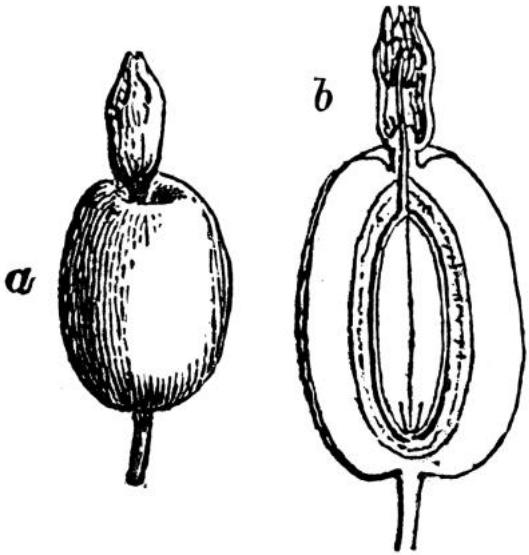
COTTONWOOD (POPULUS FREMONTII)

A seral succession is a stage on the path towards a longer lived, relatively stable but still dynamic community structure. There are processes to get to that stage, and it starts where it is and develops through many different interactions along the way. Denying the reality of this process in favor of particular players defies both science and common sense. By providing food or shelter, especially if another species previously playing those roles is now absent, Russian Olive and others keep the process of resilient renewal going. Put another way, the "invasive" label tends to elevate human perspectives of how things ought to be above non-human reliance on the present functions of how things are. How would we respond to the sudden eradication of agricultural crops, if we were to view them in the same light of stalled succession, deemed to represent a degraded habitat? Crisis! We might find a more gradual transition to be more considerate, since we presently depend on it. Perhaps our first thought would be that of planting wild foods in abundance.

A strongly held tenet of invasion biology is that non-native plants provide fewer benefits to wildlife compared to their native counterparts. In the case of both Saltcedar and Russian Olive, the data speaks otherwise. For birds in general, the composition of plant species in their habitat may be less important than the structural features those plants provide, whether native or not.[112] Some ornithologists have even found that a wide range of birds may prefer Saltcedar over native trees.[113]

The endangered Southwestern Willow Flycatcher (Empidonax traillii extimus) numbers under 500 breeding pairs. Their main threat is habitat loss, which currently includes Saltcedar. In some areas, 75% of these birds found are nesting in Saltcedar. There is also no evidence that the Flycatcher is any less provided for using Saltcedar.[114] In Arizona, 49 different other bird species also nest in the salty boughs.[115]

Bees are fond of Russian Olive flowers, and the trees were often planted for honey production. The blossoms are rich in B vitamins too.[116] Over one third of the bird species in the Gila River valley in New Mexico were observed to use the thorny cover of Russian Olive as nesting sites.[117] Since the 1950's, it has been known that at least 44 different birds (as well as fox, rabbit, squirrel, skunk, raccoon, deer and elk) eat Russian Olive berries as a hardy winter food.[118] Deer and livestock feast on the leaves. Beavers gnaw the branches. Shelter and warmth is provided by Russian Olive. Doves, mocking birds, roadrunners and other birds use the thick growth of branches as nesting sites.[119]



RUSSIAN OLIVE (ELAEAGNUS ANGUSTIFOLIA)

Defying all claims of "inferior forage" value, the berries contain nineteen detectable minerals and are rich in water and fat soluble vitamins (especially A, C and E), flavonoids, carbohydrates, alkaloids and biological active lipids.[120,121,122,123]

Theses lipids are high in essential fatty acids, which is unusual for a fruit. One study found oleic acid and linoleic acid made up 92.8% of the fruit lipids.[124] The nutritional and medicinal properties of Russian Olive are actually well studied, with indications for everything from muscle tension to malignant tumor reduction, "validated based on a scientific point of view."[125] This looks more like a wildlife super-food than an dangerous invader.

All of these services and benefits offered, and more, even after being acknowledged, are cast aside for an ideal that would take all the trees away. The USDA NRCS claimed that, "although Russian Olive provides food and cover for many species, it negatively impacts cavity-nesting birds."[126] This is stated even when the paper could offer no data that there is any competition with native species. In fact, all the papers we found could only point to Russian Olive replacing declining native trees due to various human-induced hydrological changes, and no conflict when conditions could still support natives. So the fact that these ecosystems cannot grow cavity-providing tree species is caused by environmental factors, not the new volunteers.

With remediation goals in mind, Russian Olive has repeatedly appeared in scientific literature with respect to bioabsorption, phytoremediation and degraded soil regeneration qualities. Indeed, the original motivation for planting was to revegetate land contaminated by paper mill wastewater, mine spoilings and as a

bioindicator of heavy metal pollution.[127,128] The fruits have been found to remove chromium, cadmium and nickel from aqueous solution.[129] Curiously, Russian Olive is deemed a promising species for engineered phytoremediation for herbicide manufacturing operations,[130] and seedlings have displayed herbicide-resistance.[131] So hopefully they will be there to remediate riparian soils after aerial spraying. Ironic.

The ability of Russian Olive to rehabilitate the effects of agriculture are stunning. Nutrient loss is a big factor in degraded soils, both in the field and downstream. In the field nutrients that in a natural process would be recycled back into the local soil are instead removed with the crop. Downstream from dams and the fields they irrigate, the nutrition offered by flood deposition decreases, while agricultural runoff increases salinity, affecting nutrient cycling. Endosymbiosis with soil bacteria help Russian Olive act as a nutrient pump, enabling the improvement of saline conditions by increasing "content of organic matter, nitrogen and phosphorus, as well as the number of fungus, bacteria, salt-tolerant bacteria, actinomycetes and salt-tolerant actinomycetes."[132]

RUSSIAN OLIVE (ELAEAGNUS ANGUSTIFOLIA)

Since there is no competition actually documented, and her presence remediates saline soils, it seems likely Russian Olive can pave the way for other vegetation to be able to thrive again. Russian Olive will grow in some of the most dismal conditions and has the ability to somewhat restore the historic quality of toxic sites.[133] It seems she is here to help!

But too often, these many benefits are mentioned only as an aside in the scientific literature and the focus immediately returns to methods of control, with no pause to ponder the ramifications. This behavior displays a pathological mind, unwilling to recognize facts and change course.

The tenacity of ignorance

These two maligned species, entering the scene as others are exiting, are offering significant benefits to their new neighbors: food and shelter. As it currently stands, then, removal of Saltcedar and Russian Olive—as a stand-alone action—will make some wildlife homeless and take away their food. That's a fact.

Yet somehow we still refuse to participate with the process and need to dominate. The Pecos River Native Riparian Restoration Organization, along with "weed specialist" Keith Duncan, raised $1 million to manually and aerially spray a mixture of herbicides including Arsenal, Rodeo and Roundup on Saltcedar groves on 5,000 acres along this New Mexico River. The project applied such poisons for three years, from above and below. Duncan seems to think that the dead skeletons of the trees

INSTITUTIONAL BIASES ARE SELF-REINFORCING

In the spring of this 2018, Nicole camped in a fairly remote area along Bodie Creek in Western Nevada. Many Russian Olives grew along the watercourse, as well as Willows and Cottonwood, and Pines nearby. She stayed there a week and observed the multitude of birds who visited everyday, including a flock of twenty or so cedar waxwings who chittered the morning away while they feasting on Russian Olive fruits. Quite happily, it seemed, regardless of the fact that the olives are "non–native."

While she was there, a couple of researchers from UC Berkley showed up. They were interested in the high diversity of birds in that particular canyon and had brought bugs traps to learn what the birds were eating. That the birds might be gorging themselves on Russian Olives hadn't seemed to have been occurred to them. After all, what use could native wildlife have for an "invasive species?"

This is how institutional biases are self–reinforcing. The assumption that there's nothing to learn means that nothing is studied. Not 100% of the time, but too often.

Said Nicole, in relating the story: "I cringe to think that an interest in preserving those birds will lead to the removal of their food."

provide a better nursery setting than a live shaded cover would, and that decimation is essential. However, Saltcedar provides a perfect nursery habitat for native vegetation to thrive when it is living. Studies have shown that planting native vegetation under Tamarisk is a viable way to increase avian abundance.[134]

But agricultural weed scientist Duncan assumes that destruction is the best first stage of succession. He was unashamed of describing the results as, "like a parking lot."[135] He goes on to intensify the crime, insisting that efforts "must include the entire courses of the Pecos and Rio Grande rivers as well as tributaries," and has garnered funds to the tune of $5 million dollars.[136] No environmental objections have been raised to the continued aerial herbicide application. The response has been support from Aububon, the Sierra Club and others, and the herbicide Arsenal is a big reason for the support. Wait, what? Oh, because the label states it is "habitat safe."

Duncan and his corporate environmental sponsors are still acting on the scientifically false notion that Saltcedar is drying up the rivers. Meanwhile Duncan states that "if the region gets back to more normal rainfall and snow-pack patterns, eradication efforts will become evident."[137] Thats convenient. Only if these things improve will we be able to measure success. This statement also exposes Duncan as a climate change denier. The reliable rainfall and snow-pack patterns of yesteryear are gone and they ain't coming back.

Similar aerial spray programs have been proposed (and demonstrated) for Russian Olive, again even though there have been no studies to establish competition or facilitation within communities.[138]

When the starting point is demonization, there's no room for appreciation. A blind insistence on ripping out species just for being newer, especially when they are well-established and integrated, runs the very real risk of making landscapes lifeless and barren, especially in the case of Saltcedar and Russian Olive, which

have become so common, and especially with climate change threatening the ability of the original natives to survive, period. Different groups have been trying to eradicate Saltcedar for over 70 years, and control programs for Russian Olive were demonstrated in the 1960s. Even when the true factors behind changing landscapes have been established, biocontrol agents remain the first choice.

An ugly truth is glaringly exposed by the "debate" over Saltcedar and Russian Olive. Despite the fact that the overwhelming preponderance of evidence shows that neither species is guilty of the many sins they are accused of, neither one can become exonerated in people's eyes. Saltcedar will still be seen as a sign of desolation, and remembered for that, not for the way she stepped in to provide and to mitigate human error. Russian Olive will still be considered less than other trees, even when she gave in ways that no native could. People talking about "restoration" become hooked on a picture of the past as the only healthy community possible, and all efforts are aimed at returning there, no matter the cost. There is no respect given to the resilience of ecosystems under attack by us.

Humans will never be able to celebrate healing with the rest of the world while their ideals, all of them the products of unexamined ego, continue to reign on high from above, thinking they know better than what is being offered, always.

At this juncture, the problem is not a matter of a lack of information to guide beneficial engagement. The problem is the extreme resistance to giving up our perceived place of hierarchal dominion. As ecologist Robin Wall Kimmerer recognizes: "the land shows the bruises of an abusive relationship. It's not just land that is broken, but more importantly, our relationship to land."[139]

This cycle of abuse is doomed to continue endlessly if we do not address our own embattled psyches.

POLICIES & FUNDING TEND TO LAG BEHIND SCIENCE

The fall of 2018 again found Nicole meandering across Nevada, where she ran into a Forest Service botanist. They talked for over an hour and Nicole was pleasantly surprised to be finding agreement concerning the failures of present restoration efforts.

The botanist mentioned their difficulty trying to establish native Currants on the site, even with irrigation. Nicole pointed out that the only place she had seen Currants in Nevada so far had been growing under canopy of Russian Olives along river banks. She suggested he could try that. Somewhat sheepishly he said that the grants they were seeking were for Russian Olive removal, since "they provided limited wildlife value." Surely not to the creatures eating the fruits, or to the seedlings sheltered in their shade, or to the creeks retaining bank stability when cows are held back by the thorniness.

This was a reminder that policies and funding tend to lag behind science. Even as the legitimacy of invasion biology continues to be questioned—as it has since its inception—its popularity and corporate backing lends it an inordinate voice in decision-making.

Preference and Preceding Bias

The spurious case against Purple Loosestrife

Purple Loosestrife (Lythrum salicaria) is a poster child for invasive species control. Massive eradication efforts, including the release of Black-Margined Loosestrife Beetles for biological control, have been funded to the tune of $45 million annually, supposedly based on ecological concerns.[140] But to date there is insufficient data to support such actions. What follows is an illustration of how unsubstantiated proclamations of "ecological disaster" create a "guilty" judgment that leads to subsequent research bias.

Purple Loosestrife has roots of European, Asian and Australian origin, and was introduced to the U.S. in the early 1800s. As early as the 1930s, waterfowl game managers had decided control measures were needed for this "aggressive, persistent, unwanted weed."[141] From 1953-1988, various methods were tested, with only one actual study of real world ecological interactions between Purple Loosestrife and her neighbors to see whether the presence of the plant was harmful. The first attempt to quantify such was conducted from 1978-1980 and though this study is often cited in favor of control, the inconsistent data do not support the claims of the authors.[142]

The story of Purple Loosestrife at the Montezuma National Wildlife Refuge in New York is instructive.

In 1965, waterfowl game managers at the refuge began to flood the surrounding hardwood forest to increase game production, which significantly altered the existing habitat. The results were monitored by ecologist D.Q. Thompson,[143] who found that Loosestrife easily colonized the newly flooded land. Other studies of water flow alteration showed Loosestrife colonizing alongside native species.[144]

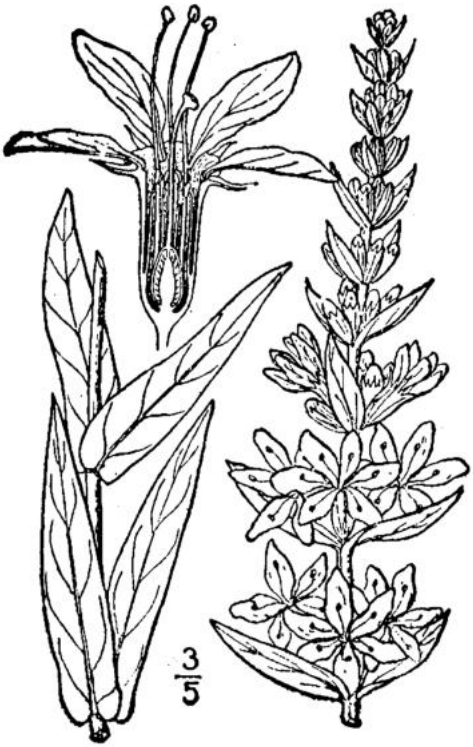
The history of massive alteration on the site of the refuge was never considered an important factor for ecological change, though it is central to understanding the place. The refuge is located on the former Cayuga marshlands, which had been drained in 1910 when the New York State barge canal was channelized and dredged, and when Lake Cayuga, which fed the marshes, was dammed. The area remained dry for 27 years, until 1937, when the Civilian Conservation Corps installed a series of dikes

that "restored" a portion of the marshes, creating the refuge.[145]

Loosestrife is a somewhat rare kind of plant: a drought-adapted wetland species. In her Australian homeland, she was able to survive the long dry periods typical of the marshes there, albeit much less conspicuously when moisture is scarce. So when water was allowed back into the refuge area, Loosestrife was quick to strut her stuff, and so began the characterization of her resilience as "aggression."

Thompson instigated a successful public campaign promoting an anti-Loosestrife biological control program even though the data didn't support it. With no apparent fear of self-contradiction, he stated that "although we need quantitative measurements of the effects," we "do not need a refined assessment to demonstrate that an ecological disaster has occurred."[146] What was left out of this "unrefined" assessment was the continued lack of any conclusive data to support his speculative observations.

A 1995 review of 34 studies of Loosestrife showed "29 species of wildlife that have been observed to use purple loosestrife" and "many field records where native species outcompeted loosestrife." Thus, "contrary to common belief, there is no evidence that loosestrife has caused declines in, or extinctions of, other species or that it outcompetes other plant species in the natural environment."[147]



So what about all the all the papers and claims and studies about Loosestrife as an invader? If you follow their references, you won't find any-thing conclusive. In some cases there is coincidental species decline with invader presence... or the opposite. Authors make use of phrases like: "no cause and effect bias can be established," "convincing documentation is scarce," "suspected negative ecosystem impacts are based on anecdotal evidence,"[148] "detailed, quantitative data are needed,"[149] "have the potential to" and "might have important implications for,"[150] "little quantitative or experimental evidence,"[151] "confer a competitive advantage"[152] and "results provide no support."[153]

Benefits of Loosestrife include the harboring of slightly more native insects and birds than nearby native plants;[154] an ability to accumulate excess nutrients from waterways; bioremediation through the ability to uptake lead in the soil[156] as well as 42 different PCB congeners from the air and soil.[155] The Middlesex Beekeepers Association claims that eradication efforts in Massachusetts have seriously jeopardized bee populations who depend on these late-season blossoms for winter sustenance. No native plants are replacing Loosestrife where it extirpated; only common Reeds (Phragmites).[157]

Preference and preceding bias are the defining factors in anti-Loosestrife sentiment, not science. Unfortunately, this story has been all too common in the history of the war on "invasives."

Climate Change
changes everything

Changing plant communities at the local scale are symptomatic of the changing climate globally. Patterns of temperature, precipitation and seasonal timing are shifting, and with them, the patterns of birth, growth, reproduction–and survival–of all living creatures.

One widely observed syndrome is "season creep," in which Spring has been arriving progressively earlier in the calendar year. For example, a survey of leafing, flowering and fruiting records from 1971-2000 for 542 plant species in 21 European Union countries showed advanced timing for 78% of the plants.[158] According to other sources, "Spring events, such as blooming, frog breeding and migrant bird arrivals, have advanced 2.3 days per decade."[159] Winter snow cover duration–as measured from Fall to Spring–has decreased throughout the Northern Hemisphere since 1978.[160] The earlier the snow melts, the less water is available during the hot summer, which affects a wide range of plants, animals and other life.

Winters have been warming. For example, the average February maximum temperature in the US rose by 0.3 F per decade from 1895-2016.[161] This general rise has been accompanied by an increase in "extreme" events, such as "false Springs" when temperatures warm up enough to trigger life cycle stages in a variety of species. When more "normal" weather arrives later–or another extreme event follows, but this time on the cold side–a plant can be injured or even killed. A common example is when a hot spell causes fruit trees to flower, and then a frost–even just a "normal" one–zaps the flowers, thereby taking out that year's harvest.[162]

When we were farmers, we experienced how extreme events affect crops. In the Spring of 2013, periods of warmer-than-average weather alternated with periods of colder-than-average weather a few times, and the transitions between them were quick, as in 36 hours. Spring greens thriving in "normal" cool temperatures would go to flower prematurely when the temperature rapidly heated up. Then, warm weather crops would stall out when the temps fell. Annual vegetable plants don't do well with such erratic conditions and we watched helplessly as our failure rate climbed.

Nicole has observed the effects of season creep and extreme events on wild plants. In one example, in the spring of 2017, she took a camping trip across the state of Nevada with her aunties, one of whom knew the area well from over 30 years of time spent in the area tending and harvesting traditional Native American food plants. The three of them visited lower elevation patches of these native plants and observed high densities of a Biscuit Root known as Rabbit Gut (Cymopterus sp.) in foothill niches against the mountains. They saw many plants, possibly due to high rainfall the year before, but no flowering although it was the season. In 2018, when the two of them visited the same patches at the same time, they found very few plants at all, across the entire state. They wondered if the plants had broken dormancy earlier, during the false Spring in February of that year, only to be sent back to sleep by the cold weather that followed. These Biscuit Roots, although hardy and stout perennials, can

only live through a certain number of aberrant events. Too many seasons of jagged temperature shifts will make their survival unlikely in their present habitat.

For each plant species—wild or domesticated—a particular range of environmental conditions supports optimal growth and reproduction, and when these conditions are not met, all stages of plant life-cycles can be affected: germination, flowering, breaking dormancy, etc. The suffering of the plants manifests in variety of ways such as stunted growth, lower seed production, and weaker resistance to disease. In the case of human food crops, lower nutritional value can be an outcome.[163] Conditions far enough outside the range of optimal are lethal, and the species will die off in certain locations.

Other species, however, will be well-suited to the new conditions, and will thrive as openings are made. Meanwhile, the original plants themselves might well have migrated to new areas themselves, filling new openings there. This is a form of natural succession that has happened innumerable times in the planet's history. The most recent globally-scaled example took place at the end of the last period of glaciation, about 11,700 years ago.

indulging in "invasion biology" at this point in history is a form of climate change denialism

We are likely already seeing such climate-induced plant succession now. It has been observed that during the past twenty five years, plant and animal ranges have been shifting towards the poles at a rate of about six kilometers per decade.[164]

However, this age-old, tried-and-true process is being interrupted in cases where a species is labeled "invasive" and is then exterminated by humans

Climate change demands that we fundamentally alter our approach to relating with the rest of nature. Continued degradation by development and expanding resource extraction is the result of what we could call an "invasive land ethic" that insists that land must be dominated. Changing this attitude is essential.

Precise predictions for the future are difficult, and many scenarios are being studied. We can say with certainty that our present trajectory is anything but stable. Under midrange global-warming scenarios, 15-37% of terrestrial species (plant and animal) will be "committed to extinction" in their current ranges by 2050.[165] This points to a practical difficulty in how to proceed with conservation and restoration plans. Everyone will be needing to adapt, and whether species can do so in place or will need to migrate and how far are hard to know. As Alejandro E. Comacho stated in reference to policy reform, it makes less sense to be "dedicating substantial resources to preserving and restoring a particular biological unit because it existed in one point in time if climatic conditions may make the landscape inhospitable to that

unit.... Similarly, what is the ethical or scientific justification for prohibiting or removing any organism simply because it never existed in a particular location, especially if that organism is now well-matched?"[166]

What hasn't been widely acknowledged yet is that restoration of previous, pre-global warming plant communities is no longer possible; conditions are already too different and the rate of change is increasing too fast. As such, indulging in "invasion biology" at this point in history is a form of climate change denialism.

Assisted Migration

In the past, climate-induced plant succession has been a fairly gradual process, taking centuries or millennia. However, in our era of increasingly rapid climate change, fewer and fewer species of plants will be able to successfully migrate. If they are to survive, they will require assistance.

Assisted migration has been finding growing support these days. In 2009, the United Nations Environment Program (UNEP) stated the possibility of necessary large scale translocations, and that "the conservation community needs to move beyond the preservation or restoration of species and ecosystems in place as the correct approach."167 The US Fish and Wildlife Service followed suit in calling for policy revisions of what constitutes native, invasive or exotic species, as well as new policies such as assisted migration to support adaptive responses to climate change.168 It is has become apparent within the domain of large scale policy that the complete dualism of the good native and the bad exotic is neither accurate or helpful at this point.

There are protected niches within habitats, or new habitats, that will provide conditions that these plants could have a chance to thrive in. A north slope of a mountain may buffer against early dormancy breaking. A higher elevation may provide the temperature relief needed for them to grow. Arguably, birds and other animals are already participating in this assisted migration, as they are often the agents moving plants into new areas.

Seed vaults are created, with controlled climates in order to stockpile seeds for future restoration, yet most conservationists balk at the idea of planting living seed banks outside of current ranges, where plants can be adapting on their own to respond to changes. How would the cold-stored seeds, with their genetic variability frozen in time, be better suited to a new environment than plant populations that have adapted to real time to emerging circumstances and have been passing that information along for successive generations?

Assisted migration is not a new thing. It has been the way of human-plant relations for many many millennia, since well before the adoption of agriculture. It is time for us to rediscover this part of our essential connection to nature.

The Scarlet "I"

The failures of science and the necessity of cultural change

The invention of "nativeness"

Describing plants as "native" was first proposed by British botanist Hewett Cottrell (H. C.) Wallace in the mid-19th century. His reasoning for the category was that local plants would show a reliable correlation with soil and climate.[169] He stated that a native species was "apparently an aboriginal species; there being little or no reason for supposing it to have been introduced by human agency." His definition included "naturalized" species who were "originally introduced by human agency [and] now exist in a wild state; some ... continued by unintentional sowings ... while several keep their acquired hold of the soil unaided, and often despite our efforts to dispossess them."[170]

In Nazi Germany, the conflict between native vs. non-native plants was put into the context of the larger war efforts. Writes journalist Andrew Cockburn:

"Nazism's view of non-native plants was consistent with its view of non-native humans. 'As with the fight against Bolshevism, in which our entire Occidental culture is at stake, so with the fight against this Mongolian invader, in which the beauty of our home forest is at stake,' wrote a team of German biologists in 1942 regarding Impatiens parviflora, a small plant native to Asia."[171]

In reference to this conflation of biology and bigotry, biologist Stephen Jay Gould warned:

"When biologically based claims have such a range of political usages (however dubious, and however unfairly drawn some may be), it becomes particularly incumbent upon us to examine the scientific validity of the underlying arguments, if only to acquire weapons to guard against usages that properly inspire our ethical opposition (for if the biological bases are wrong, then we hold a direct weapon; and if they are right, then at least we understand the argument properly, and can accurately drive the wedge that always separates factual claims from ethical beliefs).

"Any argument for preferring native plants must rest upon some construction of evolutionary theory—a difficult proposition (as we shall see) because evolution is so widely misconstrued and, when properly understood, so difficult to utilize for the defense of intrinsic native superiority."[172]

The founding tome of invasion biology was written by Charles Elton in 1958. "The Ecology of Invasions by Animals and Plants" is not really an academic book, but rather a diatribe

laden with war jargon. While suggesting that all human transportation of species is an affront to the geologic time scale (except for agriculture, of course), he also seemed to believe that all species movement since the break-up of Pangaea was invasive.

Elton's tone clearly set natives as morally superior to aliens. His war cry opposes consequences such as "dislocation, unexpected consequences, an increase in the complexity of ecosystems already difficult enough to understand let alone control, and the piling up of new human difficulties."[173]

It is curious to note that in earlier publications, Elton had promoted the concept of ecological succession "steeped in the notions of changing habitats and dispersing organisms" with no mention of of invasion. But in the intervening time, during WWII, his job focused on the "immediate needs of protecting food from rabbits, rats, and house mice as part of national defence."[174] One can't help but see the shift in perspective as mirroring both his personal and cultural experiences: nature went from an ever-changing flow of natural migrations to a static climax state suffering difficult-to-control invasions. Regardless of the reasons for his shift, his book set a bellicose tone that is still alive and well today.

The modern notion of "native" species excludes any "naturalized" species introduced by human agency, with a reference point for nativeness being, in the Western Hemisphere, 1492. There is a pointed separation imposed between "human introduction" and "natural dispersal."

Darwin's studies showed how individual birds and insects could carry dozens of seed species a number of miles, from a few to thousands. This mode of dispersal equals or dwarfs human plant exchanges.[175] "The farthest known seed dispersal without the aid of humans is fifteen thousand miles. Dust storms can carry seeds, spores, and insects from the Sahara Desert to Texas, and ocean currents can carry seeds and spores across thousands of miles of open water to inhabit new islands and continents. Darwin once commented that he witnessed seeds within the soil of a tree root stump that had drifted across the ocean."[176] Are these dispersals to be ignored as valid migration? How does human agency delegitimize the flow thereafter? This ideal ecosystem model stems from a narrow interpretation of the processes of succession, of which we are inescapably a part.

DANDELION (TARAXACUM OFFICINALIS)

Guilty until proven innocent

A major error in invasive biology is the use of the word, "invasive," as a taxonomic attribute of particular species rather than as a description of an ecological interaction.[177] That is, once a particular non-native plant is described as undesirable with any number of words (noxious, weedy, nuisance, etc.) and is thus deemed "invasive," that entire species ends up carrying the dreaded label, like a scarlet "I."

This presumption hijacks the ability to clearly see interactions in a particular setting, and severely inhibits understanding about why a change is happening and how resident plants are actually responding. The "invasive species" label tells us that because that plant was bad over there (notwithstanding whether there was any credible evidence for the accusation) it will be bad over here. This is not good science.

Assessment of the place of non-native species in the environment has evolved to an unfortunate and unscientific state of "guilty until proven innocent." A major criticism of invasion biology is that it starts from an assumed answer (non-native plants have bad effects), tests this hypothesis with no regard for other factors, and ends up relying on exaggerations of inconclusive data.

The assertion of ethical valuations that bind the field of invasive biology have led some ecologists to view it as a "pseudoscience" that has isolated itself from other ecological

insights. The good native/bad non-native dichotomy relies on circular arguments that refuse to acknowledge conflicting data; assumptions are not adequately tested and limited findings are exaggerated in too many reported results.[178]

To characterize any change at all as "harm" is to cling to an outdated idea of the environment as being settled and constant, a view that is not the consensus among ecologists. From its inception, the "field of invasion ecology has largely dissociated itself from other sub-disciplines of ecology, particularly succession ecology."[179] This has produced a narrow view that targets a few individual species as drivers of all disruption. Invasion is also claimed to be totally different from "colonization," a recognized ecological process marked by a continual, natural occurrence of habitat succession. The fact that invasion and colonization have been explicitly linked is largely ignored and "is further evidence of the persistent isolation of invasion ecology."[180]

Invasion biology has become a psudoscience, isolated from other ecological insights

"Today, fewer and fewer ecologists believe nature is either stable or perfectible. Change is the norm, they say," points out journalist Fred Pearce.[181] Since the beginning of Western thought on ecology, there has been discussion of many functional pathways. The idea of habitat succession began with the studies by Clements in the early 1900s. He promoted the idea of the environment as an organism, functioning as a whole due to a co-evolutionary process of interaction. During that same time period, Gleason talked about succession consisting of more spontaneous interactions creating habitat, focusing on the individual plants within the habitat organism, each functioning via their own relationships primarily. Somewhere along the way the idea of a rigid timeline of succession became popular, and the debate of the many pathways continues.

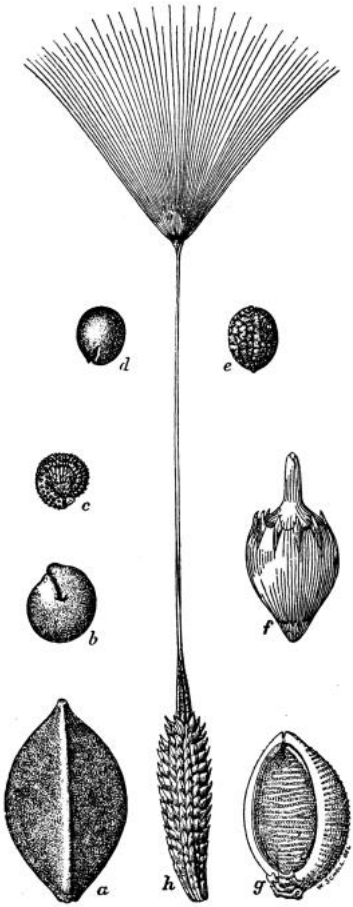
Ultimately, there are many types of relationships that mingle, creating habitats both from long term co-evolution and spontaneously kindred adaptations. In the mid 1980s evolutionary ecologist Dan Jenzen clarified the concept of "ecological fitting," in which "a species does not have to evolve in a habitat in order to participate in the interactions in that habitat."[182] Within this theory, species may have developed certain defense traits as the result of co-evolution with certain predators, but that those traits also help the species "fit" into a new community without the same pressures. Co-evolution is deemed to occur when each species imposes evolutionary selection on the other, where everyone has their place. With "ecological fitting" species may find a niche in a new community without co-evolution.

Examples of fitting can be observed today. Says biologist Dan Jantzen: "The complex interactions enacted by introduced species of animals and plants all over the tropics make it quite clear that a species does not have to evolve in a habitat in order to participate in the interactions in that habitat. Widespread species are not adapted to their habitats, they just are."[183]

Perhaps our ideas about succession are too narrow, limiting our ability to recognize it as it's happening. There is an attachment to a particular set of species selected from recent history. But just because the actors change does not mean the process of succession is

not still at play. It may be that it is more spontaneous in nature, with the familiar and exotic mixing and supporting mutual adaptation as we speak.

The long term, committed relationship of co-evolution is not the only path to intimacy. Proximity could be the catalyst for intimacy, not familiarity. "Perhaps finding an ecological niche is a bit like falling in love," as Fed Pearce mused.[184] This type of "ecological fitting" describes ecosystems as exhibiting a more fluid self-organization, with the formation of novel intimacies between previously unfamiliar species. An example would be the reality that one third of California's native butterflies now depend on non native plants for their food.[185] We could also be more fluid in our approach to stewarding resilience in the face of change.



The campaign against "invasive" species fails to accept "non-natives as valuable community members."[186] As a result, non native plants are not counted in biodiversity indices. The omission of them paints a picture of decreasing biodiversity, when in fact "the introduction of non-native species has almost always increased the number of species in a region."[187] There are a growing number of ecologists who are calling for biodiversity and sustainability assessments to capture more than just the presumed negative aspects of non-native species in order reflect the whole picture of change. Currently unaccounted for are contributions (increase in regional species richness, positive interactions with other species), and ecosystem services (i.e., provisioning, regulating, cultural and supporting).[188]

"Novel ecosystems" is a term given to new species combinations within habitats. These ecosystems are "increasingly being recognized as maintaining critical ecosystem processes, such as productivity, carbon storage, and nutrient cycling."[189] It seems essential to include them, since non-native species in some regions and cities make up over half of all species.[190] Their omission from measurements meant to provide insight creates a false narrative of how the environment is responding to change. The picture is biased towards seeing any change as degradation, instead of restorative in its own right.

As author and herbalist Stephen Harrod Buhner put it:

"We need to understand Nature doesn't make mistakes, that Earth is, at minimum, 3.5 billions years old, and that earth has been engaging in this process a lot longer than our species has existed...We need to understand that processes that no scientists understand are occurring on both very large and very small scales... So, when we see 'invasive' plants moving wholesale into new ecosystems, we need to ask in all humility, What are they doing? What is their purpose?"[191]

For the most part, invasion biology is not interested in asking these questions, but only in building a case for demonization. That's not good science. That's the stuff that cults are made of.

No wilderness to "restore"

Agriculture, and the human dispersal thereof, is distinctly absent from these considerations of invasion, which presupposes a fundamental separation of natural processes and human activity. It's as if we've created sacrifice zones in the valleys that produce our sustenance, where the same biases do not apply.

But the "wilderness" we struggle to restore here in North America is often comprised of untended remnants of the indigenous human cultures who significantly shaped their ecosystem homes, though from a place of direct connection rather than exploitation. This reality is routinely dismissed as irrelevant when it is acknowledged at all, which is not often, even though it arguably points to the way forward for the evolution of our own relationship with the planet. Instead we aim to recreate the past in the form of an idealized standard that never existed. Pearce describes this goal as "both impossible and an affront to nature, like trying to turn the world into a giant zoo."[192]

Indeed, the modern idea of "wilderness" is a new idea, and thus not something we can recreate. Many areas previously considered wilderness have turned out to be anthropogenic landscapes.[193] In our hubris, we start from a place of human separation from "wilderness" to begin a process of intense management of it. To achieve the appearance of a pristine ideal, all traces of human agency must be erased, yet the dominating mentality remains in this erasure itself. This focus on appearances detracts from addressing underlying catalysts of degradation such as agriculture, resource extraction, and pollution, to which some species of plants (non-native and native alike) are attempting to adapt.

The first step in most restoration projects is to interrupt the start at succession which nature has offered. Will we seek to conserve one part at the expense of the whole, pulling and poisoning our way back to a managed "pristine?"

Changing our cultural mind frames

Perhaps the most essential disconnect in understanding ecosystem change is inherent in the predominant cultural mind frame. Anchored in the scientific rationale are particular cultural prejudices; for example, within "Western tradition there is a recognized hierarchy of beings, with, of course, the human being on top–the pinnacle of evolution, the darling of Creation–and the plants at the bottom."[194] This hierarchal view assumes the "lower" lifeforms are somehow less (or not at all) alive, and thus have no intelligence of their own. This is not a universal perception of life. Indigenous cultures around the world have a common belief about the agency of plants and animals as sentient beings, and often look to them as sources of wisdom to teach by example, and show the humans how to live on Earth as their "younger brothers of creation."[195]

When asked about their thoughts on invasive species, Anishnaabe tradition-bearers pointed to "invasive land-ethics" as being the real threat underlining the cause of the changes we see today.[196] The "invasive land ethics" are rooted in the belief that land should be dominated, a belief imported with colonial settlement. From this perspective, environmental management practices such as the dredging, damming and channelizing of rivers are an affront, with their audacity to command and control natural processes and places. (Apparently this view extends to controlling the environmental resilience to such practices as well, as that resilience is expressed by non-native plant species.)

Kathy Leblanc, an Anishnaabe collaborator for ethnographic studies on the subject, suggested that non-native plants "may just be enacting their own migration stories."[197] In Australia, Aboriginal resistance to "invasive" eradication programs is tied to a belief "that the worth of a species lies in its ability to flourish in an environment, not in it claim to being an original inhabitant."[198]

Stewarding the land from the view point of enriching life (rather than trying to control it) is responsible for much of the biodiversity we have today. Research and stories of multi-generational use show that some of the most diverse ecosystems "were not untouched environments but the result of the last 'cycle of abandonment' by traditional users."[199] A huge example is the Amazon Rainforest.

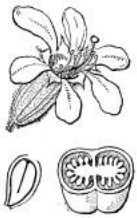
Evidence of long-term interaction can be observed other places by learning to read the landscape from a perspective of interaction, not separation. Tribal stories contain detailed information of who, what, when and how the living world was utilized towards increased abundance and diversity. The denial that previous human interaction in fact helped shape the wilderness gives credence to the proposal to remove any plant species that arrived by our hand.

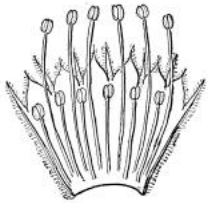
This is perhaps our dilemma: that we cannot see resilience–only misery. As Issac Yuen suggests: "Given a narrative borne out of the loss of pure wilderness, we can't help but view the world and our actions within it through a lens of self-loathing and despair."[200]

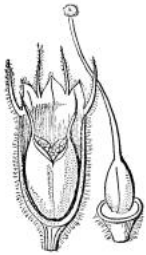
For all the faith given to scientific understanding, there is little agreement on the claims of much of invasion biology. First, such claims are too often not actually supported by scientific data, but by repeated rhetoric alone. Another reason is that science aims to understand complex systems by dissection, assuming the outcome of interactions within an entire system based on isolated findings in isolated portions. The lab does not translate well to the field. A third reason is that science is not an unbiased inquiry when assumptions are a part of the hypothesis. That means other factors are not studied, and the aim is to prove what is expected.

Our understanding of ecosystem dynamics and the factors of resilience cannot not be known by science alone. As Robin Wall Kimmerer puts it so succinctly in her book, "Braiding Sweetgrass": "Science as a way of knowing is too narrow for the task."[201]

We must do nothing less than address the fundamental ways in which we relate with nature and radically change them. The needless killing must stop.







Endnotes

For URLs, visit macskamoksha.com/2019/01/invasive-zine-notes

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imagine...

Imagine that the term "invasive species" didn't exist. Imagine that another current term was popular instead, one that is already used to designate plants who are the first to establish themselves in a newly disturbed area: "pioneer species."[202]

Imagine further that its synonyms were not "aliens" or "non-natives" but "explorers" and "frontier-species."

Why, such plants would be celebrated for their patriotism! They would be called "brave" not "aggressive," "ground-breaking" not "encroaching," and "thriving" not "threatening."

Now imagine the uphill battle you'd have trying to convince people that the "pioneers" were having negative effects and needed to be controlled; that, in fact, their heroes are villains. Imagine trying to attach the adjective "invasive" to "pioneer." That would never fly (despiteor because of?its historical accuracy in the case of human pioneers).

Your campaign would be fruitless and lonely. (And you'd know what it feels like to be an anti-imperialist in the USA!)

Just as rain, wind and sunshine are not good or evil, neither is any particular species of plant.

We are not seeking such a drastic shift, from one extreme to the other. Rather, we would like to see the discussion of new plants taken out of the realm of value judgments entirely and instead be based on in-person observations, on-site analysis and real world participation. Put simply, we are seeking to look clearly, reckon truthfully and act sensibly.

But maybe this is wishing for an even more radical shift. Perhaps trying to convince people that good is evil or that evil is good is less arduous than trying to convince them to have a conversation that isn't about either one.

Said philosopher, Jiddu Krishnamurti: "Your whole life is divided into opposites – virtue and non-virtue, right and wrong – because you never meet life completely but always with this reaction, with this background of division. You have created this background; you have crippled your mind with these ideas..."[203]

In other times and places, we believe, humans were not so crippled. Not that there wasn't danger or conflict, butseen without the distorting lens of dualismthose are merely conditions of living that come and go like conditions of weather.

Just as rain, wind and sunshine are not good or evil, neither is any particular species of plant. In certain situations, as measured by certain criteria, we might find certain plants to be helpful or harmful. But all that certainty is only in our mind.

We would like to see the discussion of new plants taken out of the realm of value judgments entirely and instead be based on in-person observations, on-site analysis and real world participation.

For example: If we are hungry and find a blackberry bush full of ripe fruit, we might love the plant and call it a friend. If we are thirsty and are blocked from a riverbank by the same bush's thorny vines, we might hate it and call it an enemy. In both cases, the emotion and the name-calling are ours, and ours alone. The blackberry bush did not change. To insist that our characterization of the plant in either of these discrete instances is equivalent to describing the intrinsic nature of the species as a whole is delusional.

Yet, this, in a nutshell, is the assertion being made with the application of the loaded word, "invasive" to an entire plant species. A certainty has been proclaimed.

Returning to the blackberry, let's say that we encountered it first when we were thirsty and acted on our certainty of its evil nature in that moment to hack it down to the ground. After having a drink at the river and taking a nap from our labors, we later wake up hungry. Making our way back up the bank, we don't even notice the smashed berries in the dirt as we step over the chopped canes. After all, that plant was no good, didn't belong there, and the world is a better place with it gone. Can't wait to track it down and kill it everywhere else we find it.

Such behavior saddens and enrages us. We see no maturity or intelligence in such attitudes and actions.

Imagine a world not divided into "good" and "evil." A world without antagonism, hostility and competition. A world, instead, of openness, respect and cooperation.

Imagine <u>that</u> world, if you can.

Blackberry (Rubus sp)

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