

“Resilience From the Perspective of an Ecologist”

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I was trained as a plant ecologist, so I am a botanist, and I have worked in highly managed agricultural systems and thus I often call myself an Agroecologist, but I have also spent significant portions of my career studying invasive plant species in more “natural” settings. I think ecologists have gained a great deal of knowledge about resilience in ecosystems and I hope the lessons from ecology, as I interpret them, might be useful in gaining resilience to the challenges to our environment and even us personally.

Before I talk about these lessons from my science, I want to acknowledge the best example of resilience that Reverend Peet talked about last week, and that is our native American hosts on this land. They have survived genocide and intentional cultural destruction at the hand of our forefathers. After 150 to 300 years of this treatment they are resurrecting their cultures, languages and sovereignty. That is resilience! ...and we must facilitate it in every way possible, because their lessons may be crucial to our survival as a society that respects pursuit of happiness and justice for all. I recently have put much thought and applied research into resilience to climate change.

Specifically, I have offered up ways for land managers to best respond to climate projections for Montana that often have a high degree of uncertainty. Finally, my other credential for understanding the concept of resilience comes from surviving the death of a child. By far, the most difficult event in my life and finding a way to move on has been a difficult task. However, we live in a place and time that makes life relatively easy and we have the luxury of this place and time to shape our resilience to even the gravest of future threats. I am optimistic that we can, and I believe that ecology may provide a way of thinking that can help us.

Ecology is the study of how organisms interact with their environment. In that organisms are bound to the genetic based laws of evolution, organisms adapt to, and often shape, the environment most local to them and those most challenging their ability to pass along their traits to future generations. One may argue that through adaptation we are predisposed to resilience and in an evolutionary sense we can provide for resilience by maintaining a diverse gene pool. “Variety is the spice of life, and maybe is essential for life!” Do we have the diversity required and is the process of adaptation rapid enough to maintain the essential diversity? ...become the crucial questions. The short answer is “Yes.” Rest assured that there is plenty of evidence that evolution can become a rapid process. The uncertainties of the future or lack of experience with unique futures can work against adaptation and make organisms including humans less resilient. Loss of species has been more the result of over exploitation and habitat loss and fragmentation which are very manageable. So we can manage for the basic requirement of ecosystem resilience. The greatest challenge to ecosystem resilience may be the uncertainty for ecosystem managers given potential drivers like atmospheric gases driving climate change and a whole host of cascading complex interactions in ecosystems due to the changes. Perhaps the way to be most resilient to uncertainties in the challenges from the environment, both local and non-local, is to be aware of what drives system dynamics. Then use that awareness to shape our environment to maximize our resilience. I think there is great parallel between ecosystems and our personal life in how we can shape our resilience. Resilience of the earth biota may ultimately rest with our personal ability to be resilient.

Humans are managing, or see themselves as manipulators, of ecosystem for the human goals of production or conservation. Keep in mind that these goals are influenced by the environment, how the managers view the goals, and policies that often constrain the goals. For example, a farmer tends to see their ecosystem as one

that requires management to maximize returns on investment usually on an annual cycle, but with attention to maintaining the maximization goal in the future. The scale of future is influenced by how the farmer relates to their system which in turn is highly influenced by policies like price supports, tariffs, etc. All of these factors influencing the agro-ecological system are creating extreme uncertainty in how to manage even for the simplified goal of production or return on investment. Subsequently, Montana has very high suicide rate in rural areas where producers are faced with high uncertainty in the outcome of their decisions. They are the opposite of resilient, they are brittle to the point that they break. If a crop producer does not know the price that he or she will receive for their crop when they plant it, or if crop pests severely decrease the yield, or if the weather has extreme events or drought that reduces the potential to have a profitable yield... the uncertainty is the greatest challenge to resilience of their agronomic system. Most of these uncertainties have sharply increased in recent years. A wrong or expensive input decision could make the difference in economic viability and sustainability of production. For example, wheat farmers tend to purchase expensive fertilizer and pesticides to apply to their crops even though it often does not have a return on investment. They tend to use inputs as insurance, but only get the full return on investment with low frequency. Spreading the risk among years by reducing inputs will increase resilience of the farmers to the many compounding uncertainties that confront them.

The ecological approach to the problem of resilience Applied ecologists tend to see ourselves as helping people achieve the goals of production and sustainability, and where these goals overlap on the landscape there tends to be tradeoffs in achieving the goals. Further, even trying to maximize one of the goals is difficult because of an ever-changing environment. ...And since ecology is the study of how organisms interact with their environment the changing environment creates moving targets. If we think of the environment as having biotic and abiotic components forming an interacting web of organisms all interacting differently with the abiotic environment this creates complexity. If management is prediction, then how do we ever predict ecosystem outcomes with the complexity of these interactions? Once more, if previous boundaries on the environment are exceeded, as with climate change where there is no analog for system behavior, uncertainty in outcomes goes through the roof. Uncertainty becomes stress and makes the system brittle... not resilient.

By the very act of being the manager, we tend to separate ourselves from the ecosystem, or at least we tend to view the ecosystem as something that really is only present for the purpose of serving us by producing our food or preserving biodiversity as a bank for future human goods. We often even refer to the delivery of goods as “ecosystem services”. Hunter gatherers tend to have a different perspective that embeds them in the ecosystem and thereby provides inherent resilience. The “be here now” perspective allows, not just buffering capacity but also an ability to thrive in adversity, which is ultimate resilience. Further, I believe that localization of the problem of uncertainty and subsequent stress points, tends to provide for the greatest resilience because it reduces the scale of the problem of uncertainty. It makes the uncertainty tangible and the mechanism to build resilience more obvious and tractable.

Perhaps we need to turn our perspective inward, localize the global issues, localize our relationships with the things that matter like our food system. Deal with climate change locally. Achieve community scale carbon neutrality and local adaptation mechanisms that have local relevance. As we move to a decarbonized economy prepare for a local workforce change. Maximize the efficiency of our communities and our lives. Get involved with local land use policy based on an understanding of the different local perspectives on the policy. Understand our system at a scale that it is understandable and draws on a keen awareness of our local surroundings. Be here now. In my agricultural research, I have shifted the tenant of agriculture from generalized prescriptive State-wide management recommendations to localized development of understanding to build resilience. It turns out that every field planted to a crop performs differently. Every pasture produces forage differently depending on its location, time at which we observe performance, and the history of activities on the field. My students and I now build tools for farmers to understand their system

forming a basis for decisions based on the probability of outcomes, not what the decision should be. I like to tell farmers I am trying to make them a better gambler in the face of uncertainty. Understand your system and its response to inputs. Learn to recognize when your decisions might be detracting from resilience. Be here now and engage your ability to place your system in a historic and future context. The industrialization of agriculture tried to make a single deterministic recommendation for an entire State. This drove our agricultural system to be very input dependent, where inputs of fertilizer, genetically homogeneous seed, herbicides, insecticides, fungicides, insurance all removed the need for understanding the underlying natural processes governing productivity of systems and how it varies with place, time and history. Single prescriptive management ultimately has minimized resilience by making crop or food production an industrial process. The discipline of agroecology is turning this approach around and substituting knowledge for inputs with particular focus on building resilience. Coproducing knowledge, farmers and scientists, are changing the face of agriculture. In all parts of our lives we are being manipulated by media and relationships that try to impose global norms of tribalism distracting us with externalities that are largely out of our control. I strongly believe that localized relationships born from understanding our common constraints and goals will build trust among us and thus resilience so we can thrive in adversity. If we pit ourselves against each other, we make our systems brittle. Darwin, made it quite clear that mutualism is, at least, equal to competition as an outcome of coevolution and the empirical evidence indicates that mutualism may be the most frequent outcome of natural selection.

We must change the context of our narrative from how ecosystems provide services for us to how we partner with ecosystems to ensure our traits, and the traits of the species we share the ecosystem with, are passed to future generations. We must be here now. Maybe Chief Seattle said it best when he said: "We do not own the land, but we borrow it from our grandchildren."