Webinar Brief for Resource Managers

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Understanding Resistance to Invasion and Resilience to Disturbance: Importance for Restoring and Managing Rangelands

Presented on April 20, 2011 by Jeanne Chambers, Research Ecologist for USDA Forest Service Rocky Mountain Research Station

Management Implications

- Resistance to invasives and Resilience to disturbance are key factors of an ecosystem in returning or remaining at certain ecological states
- Once an ecosystem crosses a threshold into another, it may not be possible to return to the previous state
- In some cases, the most effective management strategy may be inaction depending on the characteristics of a site that relate to Resistance and Resilience

Project Summary: Jeanne Chambers discusses the importance of resistance to invasion and resilience to disturbance in restoration and management of Great Basin rangelands. She gives some examples and research on adaptive management.

Abstract: In recent years, there has been increasing attention from climate change applied ecologists on restoring and maintaining desired ecological states. Within the Great Basin, one of the most highly desired states is non-invaded sagebrush communities. When evaluating the response of a site to a disturbance, such as fire (which is increasing in frequency as a result of climate change), two key characteristics must be considered: Resilience to disturbance and Resistance to invasive species. Resilience is the capacity of an ecosystem to regain characteristic processes over time following stress or disturbance; it is a measure of recovery potential. Associated with Resilience are Thresholds, a point at which the ecosystem does not have the potential to return to the original state via natural processes following a disturbance and requires active management to restore; when an ecosystem loses its Resilience. Resistance is the ability of an ecosystem to maintain characteristic processes despite various stressors or disturbances; Resistance to invasives are the biotic and abiotic factors and ecological processes in an ecosystem that limit the population growth of an invading species. Resistance and Resilience are extremely important in the Great Basin, where fire frequency is increasing and invasive species, such as cheatgrass and native pinyon-juniper expansion, are a real problem. Prioritizing the maintenance of Resilient and Resistant ecosystems is key; the major

ecosystem managed for in the Great Basin is sagebrush communities. Resilience and Resistance change over several different gradients, including soil temperature, soil moisture retention, elevation, slope aspect, precipitation, and climate, to name a few. Seed sources (of natives and invasives), pre- and post-fire weather, pre-fire vegetation, woodland phase, and pre- and post-fire grazing activities will also influence Resistance and Resilience. As a rule of thumb, Resistance tends to increase with increasing elevation, due to lower temperatures. Conversely, on warmer/lower sites, Resistance can be lowered. Proper post-disturbance management of the site is crucial to retain an ecosystem's desired ecological state before crossing thresholds. Each site is unique in terms of its response to disturbance, so we would recommend using the Great Basin Fire Science Delivery's new field guide: *Rapid Assessment of Post-Wildfire Recovery Potential in Sagebrush and Pinyon-Juniper Ecosystems in the Great Basin: Field Guide for Evaluating Resilience to Disturbance and Resistance to Invasive Annual Grasses and the Need to Seed.* It offers methods and score sheets to evaluate Resistance and Resilience, as well as offering advice on the course of action for an area based on management objectives. Copies are free; please contact GBFSD (www.gbfiresci.org) to request a copy.

Questions:

Where is grazing most often occurring? What type of system?

As a research ecologist, I might not be best to answer. I have worked on BLM districts and USFS districts. In terms of environmental or elevation gradient, grazing occurs at all different elevations. It depends on the permitees and their needs at the time, and also, the decisions of land managers to which grazing allotments are currently active, to those that are not. I'm not sure that answers your question.

Many of the concepts discussed here are similar to the FRCC concepts; have you looked into how to incorporate the two?

I have looked at several different management schemes that are currently being used. There are several that try to incorporate these concepts and terms and how they are being applied. They are being included in state and transition models, and I know that David Grisky and Tansem Stringham have been working on those particular concepts. Work by Louie Proventaire has tried to also incorporate at least the ideas of the FRCC. I would be happy to discuss this more in depth individually.

When is the landscape level control on *Bromus tectorum* expected to be in print? And in what journal?

Landscape level controls are already in print. There were in Ecological Monographs in 2007, where I was the primary author. It includes all data on cheatgrass described today, plus a lot more.

How does this information apply to wild horses, or are wild horses included in grazing management?

I believe that horses would necessarily be included in grazing management. They have a similar, if not greater, effects ecosystem recovery than do cows and other livestock.

On sites where there is relatively high perennial understory cover, correlated with sagebrush, what management opportunities might help us promote high perennial cover?

I think the best option would be to monitor these sites over time. If we start to see changes in the ecological conditions, then we might want to consider going in and doing some type of treatment. Otherwise, they are probably best left alone.

What was the intensity of fire used or present in the Rau et al. study, which found an increase in soil nitrogen post-fire?

That was a prescribed fire in the Underdown Range. It was part of the Joint Fire Sciences Program demonstration area looking at the effects of prescribed fire in Pinyon and Juniper dominated watersheds. Basically, the intensity of the fire would have been relatively low. Those were mostly spring burns and fire temperatures and soil temperatures, again, were relatively low. We have those data if you are interested in them, I'd be happy to share. In fact, you can look up the Rau et al. manuscript; I know that Ben has those temperatures in that particular manuscript. It's Rau et al. 2007: Fire in the Great Basin Effects on Nutrients, he has several of them. Please email me if you would like details on the manuscripts or the soil temperatures associated with the burns.

What is FRCC?

Fire Regime Condition Class

Followup: It is an interagency term that came out of the LANDFIRE Project. Fuels projects and all Federal agencies are required to assess the impact on FRCC.

Which ecological community species are projected to be resilient for increased temperature and drought?

That's a good question, one that I'm not sure we understand right now. We would expect lower elevation and more arid systems would be the least resilient. An excellent example is Bethany Bradley's paper in which she looked at the increases in temperature in an area just outside of Ely, NV, and what the effects might be on those systems. What she found was that temperatures could increase to a degree that not even cheatgrass would be able to survive and persist on those sites, and that we might see these sites transition to more Mojave type conditions. However, we may also be looking at novel community types or novel situations that we have not seen in the past.

Is there a resiliency guideline as far as perennial plants density and/or cover are concerned? In other words, is there a guideline like 2 to 4 deep-rooted perennials per square meter equals resiliency?

The only ones I know of are those that Rick Miller has come up with. Those are more for the northern western Juniper systems. And they believe that 1 deep rooted perennial species per meter square would allow those systems to recover following fire. However, what we have to consider is that as we go across these elevation gradients, we would expect that those numbers and those covers would change considerably. We may have some fairly good data coming pretty soon from the Joint Fire Sciences sponsored project, the SageSTEP project. And what it could do would be to give us an indication, at least for the sites that were studied, what level of perennial herbaceous species resulted in adequate recovery of those particular sites.

Under what conditions would cut and leave be favored over mastication? Does mastication alter composition of native herbs and grasses unfavorably in the system studied?

To date, I don't think we have enough data on mastication and their long term effects on soil nutrients or plant species composition to be able to state what the longer term effects are going to be. Hopefully those data will be forthcoming.

For higher elevation forested sites, what kinds of treatment strategies would you propose that reconcile historic fire regimes, moderate to high frequency mixed severity, and forest structures with current stand conditions and restoration means?

I'm not sure if you are talking about woodland or forest sites. In terms of woodland sites, of course we would want to be very aware of where we had our older, more persistent, pinyon and juniper systems. And we would want to try and

identify those prior to any treatment and to avoid either burning them or doing any kind of mechanical treatment on them.

Follow up: I'm asking about forested sites with ponderosa pine, firs, or five-needle pine, many of which, but certainly not all, have secondary post logging tree cohorts.

I have not worked in those systems, I defer to Stan.

How do you promote resistance and resilience in areas burned by wildfires?

It depends on if you are talking about before burning or after burning. If they've already been burned by a wildfire, we need to assess what the residual perennial herbaceous component is. If there is significant perennial herbaceous component, and if we are at relatively higher elevations and higher precipitation zones, then perhaps we would not want to do anything but allow natural recovery. We can promote resistance and resilience by decreasing any additional stressors to the sites; deferring grazing, and then only moderate grazing, after we begin to regraze those sites. If we're at lower elevations, perhaps, and we know that we already have very low perennial herbaceous species, then we can perhaps increase the resistance and resilience of those sites by seeding with a diverse species compliment. The problem here is that our lower elevation systems, it is often very difficult to establish native species.

How does grazing intensity interact with disturbance and fire on system recovery?

I don't believe we have enough data for that question. I think it's an area that deserves additional study. A lot of what we could conjecture from past studies, we would expect more intense fires would result in lower perennial herbaceous species afterwards, and consequently, they will provide less forage. If we go full circle, grazing of those sites might have a greater impact in terms of decreasing the rate of recovery.

Are there studies anywhere to see if mastication results in greater soil carbon?

Work has been done by Ben Rau and Dale Johnson, on the effects of mastication. I'm not sure if they have published that yet. Another study is nearing conclusion by Bruce Roundy and his graduate students.

How long does it take for fungi to come back after fire? In regards to Wyoming big sagebrush establishment.

Not prepared to answer.