# Fire Ecology Chats: A Podcast Series by the Association for Fire Ecology

**Transcript of Episode 12 - Detecting Shrub Recovery in Sagebrush Steppe**

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**Bob Keane:** Good morning everybody. My name is Bob Keane. I'm the host of the podcast, Fire Ecology Chats. We're so glad that you can listen to another one of our chats. And today, we're excited about giving you a really important new paper. The paper is called "Detecting shrub recovery in sagebrush steppe: comparing Landsat-derived maps with field data on historical wildfires." Today, we have two people to talk about this paper, the senior author Cara Applestein and then Matt Germino. Cara, could you introduce yourself and your affiliation please?

**Cara Applestein:** Yes, I'm Cara Applestein. I'm an Ecologist at USGS in Boise, Idaho, and I work in Matt Germino's lab.

**Bob Keane:** And Matt?

**Matt Germino:** Yeah, so Matt Germino, Supervisory Research Ecologist here with USGS for the last 10 years in Boise, and we look at post-fire restoration in sagebrush steppe.

**Bob Keane:** Wonderful. So Cara, why don't you give us a rundown on the paper. What's it all about?

**Cara Applestein:** So basically, the background context for this paper is that sage steppe ecosystems have really become imperiled by invasive species and also by large scale wildfires. So sagebrush is a keystone species that provides habitat for a large number of animals, and it has been lost across nearly half of its historical range. And so many of these large wildfires that are happening in recent years, they occur in remote areas that have limited on the ground data. And there are a bunch of remote sensing methods that are providing means by which land managers can gain information about these landscapes and how they recover after fire. However, many of these remote sensing methods haven't necessarily been tested for how well they compare with on the ground monitoring efforts, particularly when you're talking about this scale of treatments or landscapes. So we were just interested in looking at post-fire landscapes, we looked at about nine different fires across the Great Basin that had sagebrush monitoring done on them across a several year period. And then we also looked at the Soda Wildfire, which happened in 2015, and looked at sagebrush monitoring on that as well. And basically, we're just seeing how well these monitoring on the ground methods compared to remote sensing for sagebrush regeneration and recovery over the course of 5 to 20 years after fire. And we found that the remote sensing products, and the one that we particularly looked at was the NLCD, which is the National Landcover Database. We looked at that how sagebrush cover, the trajectory of that after fire, and what that trajectory was like.

And we found that that product could show a fire recovery signal. About four to six years after fire, we saw that there was a stabilization of the sagebrush recovery in the area, but that it did tend to overestimate the amount of sagebrush recovery that was actually happening when compared to monitoring efforts on the ground. So we think that there's really some good potential to use these remote sensing products for looking at sort of the overall trajectories of post-fire recovery, but it may be good to pair them with on the ground monitoring that can get that smaller scale variants.

**Bob Keane:** Yeah, that was very interesting. So Matt, what are the problems of detecting sagebrush in such a large area? They're very patchy and very widely distributed.

**Matt Germino:** Yeah, well, actually, the patchy thing that you note is really key. I want to start by saying that the seeding of big sagebrush is one of the most extensive land treatments underway in wildlands worldwide. In fact, the Bureau of Land Management, I think, is the largest purchaser of wildland seeds in the world. And a large part of their purchases are these tiny sagebrush seeds that are broadcast from airplanes. So it's extensive and that makes it a good target for remote sensing. These are also semi-arid areas that are relatively clear and cloudless, which you think that that would enhance the likelihood that remote sensing would work. And furthermore, Bob, sagebrush is one of the only evergreen species in these landscapes. So for many months of the year, when all of the grasses are brown and straw like, sagebrush should stand out in contrast. It's kind of grayish green and the only thing out there that has some green in it, generally from July all the way through December until the snow flies. But the problem is that these sagebrush are relatively slow growing after fire. So number one, they're obligate seeders and they're fire tolerant, and so that's why they're seeded. But it's usually many years to decades before you get a substantial canopy coverage that would provide a strong signal to a satellite sensor. For example, in the first year you might have seedlings that are only like an inch or two tall and could pretty quickly become occluded by overtopping grasses or other herbs, and therefore be very difficult to detect with a satellite sensor, or even like a UAV. And often, frankly, even field technicians. Sometimes you got to get on your hands and knees and stick your fingers in the grass to detect these little buggers. The question then, is when do those sagebrush start protruding enough through the understory and provide a strong enough signal that the satellite can actually detect them at the 30 meter pixel scale? That's the real crux. And the thing is, we could wait until the signal is strong. But the critical management interventions, unfortunately occur within those first few years after fire. That's the opportunity for the managers to intervene with herbicide treatments or modifying grazing or applying additional seedings to get this recovered. So the problem is that, you know, a few reasons why we think remote sensing would be a compelling application here. But on the other hand, there's some really challenging technical issues, because we're really pushing the envelope of technology to try to detect a signal that is actually kind of faint because of the slow recruitment rate and growth of the canopy after fire.

**Bob Keane:** That was incredibly interesting that sagebrush had to get above regeneration before it can be detected. One of the things that I was impressed about the paper itself was the huge number of plots you had Cara. Can you tell us about the field campaign that happened to get that number of plots?

**Cara Applestein:** Yes, this data came from two different projects. One of them was the SageSuccess project, which occurred over a large number of fires. And we actually only selected nine of those fires for this paper. And it was basically a chronosequence, so the fires ranged in age and how old they were when they were monitored. So we have that data and that spanned a large area across the Great Basin. And then we also had plots from the Soda Wildfire. Those have been collected for five years, actually, and for this paper, we used three years of that data. But there's about 2000 plots that were monitored across about 250,000 acres of the wildfire. They were

monitored on successive years. So we really have some pretty intensive data there. That was a very large monitoring effort, really one of the largest monitoring efforts that has happened on a wildfire of that size.

**Bob Keane:** Yeah, it was quite impressive. So Matt, do you think that using the Landsat Thematic Mapper sensor is where we should go in the future with the NLCD? Or should we take a look at other senses? Could they be better to detect sagebrush distribution?

**Matt Germino:** Well, the NLCD is a major accomplishment. We've all known that this Landsat archive, these bi weekly images have been available for many years, but it's really only been recently that the computational abilities to digest the data into fractional cover have been available. So currently, it's a great tool. And I want to emphasize a great tool for application at broad spatial extents. One of the lessons from this paper is that when you begin looking within an individual fire, even if that fire is 300,000 acres or more, the error, especially when sagebrush is recovering, that error becomes an issue. So, even though we detected a fairly large discrepancy between what the satellite was estimating for sagebrush cover compared to the field, we still use the technology, we still use the data for our other research. But when we apply the data, we use statistical methods to factor in the error into our analysis. And that's a really critical thing all too often, its very convenient to use these sorts of data. They're readily available, and you can download them. And we're seeing lots of different researchers and managers apply them. But we rarely see the application formally incorporate that error. So no, the short answer is caveats for applying the data to individual burned areas, and especially looking at variability within a burned area, and that's unfortunate, because, you know, like you started the discussion, sagebrush recovery is patchy. And the assessment of sagebrush recovery must formally look at that patchiness rather than seeking to characterize average responses over large burned areas. But unfortunately, it's at that scale that the reliability of the remote sagebrush assessments begins to come into question. And instead, people should feel more secure in applying these sagebrush remote sensing models at very broad ecoregional levels, which by the way is very valuable. For example, in Bureau of Land Management needs to make critical decisions about where to invest into a sagebrush seeding and recovery. Right now we're battling with trying to keep the greater sage grouse off of the endangered species list. That species require sagebrush for its food in the winter. And we can't see every burned area. So which burned areas should be dealt with? And after you see is the sagebrush option recovering in certain regions? And so you could answer those kinds of questions, in light of the error at very broad ecoregional scales, like across the entire northern basin and range and central basin. That's the correct scale of application we think.

**Bob Keane:** So speaking of error, I thought it was really interesting that there was a 6.5% over estimation of NLCD sagebrush cover. Cara, give us a little more insight into that error estimate?

**Cara Applestein:** Yeah, one thing to consider is that the max sagebrush cover that was found in any of our areas was about 35%, so you can think about that 6.5% sort of on the range of sagebrush cover. And that overestimation did surprise us a little bit because as Matt stated earlier, you would expect that small sagebrush seedlings would be very difficult to detect after fire. And we were expecting that maybe we would actually have an underestimation. But basically what's going on with that is a false moderating effect. And so that means that typically with remote sensing, very low cover tends to get overestimated and very high cover tends to get underestimated. So you sort of have a lot of the ranges of cover being pulled more towards that middle range. I think that the overestimation put it fairly comparable to other remote sensing products. For instance, the Rangeland Analysis Platform, which is another product that is out there, they state that their range of error is about 6 to 7%. You know that that's likely to be your range of error, you can take that into account, you can take into account that maybe you're having a 6.5% over estimation of sagebrush, and when you're looking at cover ranges that are starting to get larger, taking that into account is maybe not that problematic. We did see on the

Soda Wildfire that many of our plots, although we saw sagebrush restoration occurring in the field, that those cover ranges were still very, very low, I mean, frequently less than 1% within the first couple years after fire. So it just goes back to the point that right after fire, if you're very concerned about seeding treatment effectiveness, that is probably going to be critical time period during which to get on the ground monitoring because that that range of error and the remote sensing is not going to be able to detect that very, very small scale change that is occurring.

**Bob Keane:** Well, very interesting. I really appreciate you two coming on this podcast. It's an incredibly interesting paper. This paper is available of course at *Fire Ecology*. Cara, would you like to acknowledge any granting agencies or people that contributed to the study?

**Cara Applestein:** So the funding for this study was provided by the US Northwest, Southwest, and North Central Climate Science Adaptation Centers, so we'd like to thank them. And then of course, the data on the ground came from the SageSuccess project and the Soda Wildfire Project. And there's probably more than 30 field technicians that worked on that project, so we'd like to thank them as well. And also Matthew Rigge and Collin Homer; they're the original creators of the National Land Cover Database data, and they provided some really great feedback about that as we were working on this project.

**Bob Keane:** Matt, you have anybody you want to recognize?

**Matt Germino:** Sure, the Bureau of Labor Management and Joint Fire Science Programs also provided some of the underlying support for this, especially the Bureau of Land Management. They are major end users of data. So we've really enjoyed having a close, in a way coproduction of this science. We're very close partners in the collection of the vast and intensive datasets, which I want to point out are some of the only datasets that are collected at the scale of which satellites see the earth. So only data that are suitable for scaling up to 30 meter pixels across broad areas.

**Bob Keane:** Great. Thank you again, Cara and Matt for joining us here and everyone if this paper interested you please download it from the *Fire Ecology* website. It's free and think about publishing at our journal *Fire Ecology*. Thanks, everyone. See you next time.