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

Transcript of Episode 13 - Predicting wildfire impacts on the prehistoric archaeological record of the Jemez Mountains, New Mexico, USA

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Guests: Megan M. Friggens (USDA Forest Service) and Rachel A. Loehman (US Geological Survey)

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Bob Keane: Welcome everybody. My name is Bob Keane. I'm the editor of the journal Fire Ecology that is sponsored by the Association of Fire Ecology. And today we have two wonderful guests on a very exciting paper that is on a field that is not very studied very much, but is incredibly important. Today we have, the paper is, Predicting wildfire impacts on the prehistoric archaeological record of the Jemez Mountains, New Mexico, USA. And the two people that are going to talk about it are Megan Friggens and Rachel Loehman. I'll have you introduce yourself, Megan.

Megan Friggens: Well, thank you. Hi, everyone. My name is Megan Friggens. I'm a research ecologist with the Rocky Mountain Research Station. And I work out of Albuquerque, though I work in many different areas of the western US.

Bob Keane: And Rachel?

Rachel Loehman: Thanks, Bob. Hi, everyone. My name is Rachel Loehman. I'm a research landscape ecologist with the USGS, and I also live in Albuquerque. I work in the Jemez Mountains in New Mexico, but also in Alaska.

Bob Keane: Well, welcome you two. And thank you for taking your time to answer these questions on this very important paper. Megan, can you give us the quick rundown on what the paper is about?

Megan Friggens: This paper is about trying to develop some models to predict how environmental conditions can impact or influence our observations of fire effects on archaeological sites within the Jemez Mountains of New Mexico. So archaeological records are really important, but they're also finite resources in our landscapes. There's areas within the US that have a large number of these sites and so it can be a huge task to try to survey these sites. And this task of surveying and gathering information before it's lost becomes quite urgent when you're dealing with fire prone landscapes, given that fires can impact those records. And so, this analysis that's described in the paper is actually just part of a larger project that Rachel was managing, that was funded from the Joint Fire Science Project. And it looks at how well we can use remotely sensed and spatially derived predictors of landscape conditions to predict fire effects and fire severity on archaeological sites in the Jemez Mountains.

Bob Keane: Oh, that's wonderful. Rachel, can you tell us about that larger study? How does that mesh with this current study?

Rachel Loehman: Some years ago, Joint Fire Science Program recognized that fire effects on cultural resources, on the record of people who lived in the past, was a topic of increasing importance. Land managers and archaeologists were having to manage these cultural resources on landscapes that are progressively more fire prone, using management tactics that maybe are having to be progressively more intensive. And there wasn't a lot of information on how fire effects or how fuel treatments and prescribed fire affect these cultural resources. So one question had to do with how much of the landscape had to be treated, how intensively archaeological sites needed to be treated, and then if or when wildfires burn or when prescribed fires burn across these sites, what the effects are to the individual artifacts on the site—pieces of pottery, the architectural remains that are on sites or stone tools—what those effects are, and then how we might mitigate any unwanted effects, the types of effects that destroy or compromise the record. So Joint Fire Science Program funded a project that we call ArcBurn, which was or is—it's an ongoing project even beyond the funding—which is aimed at providing fire managers, archeologists, and research community with information, tools, data, knowledge on the relationship of fire and cultural resources. And one important part of that relationship is how fires interacted with cultural landscapes of the past. So in the Southwest, the fires that burned in the past, were not as severe. And so some of these resources have been exposed to fires over and over again, but it's not until the past 100 or so years that those fires were damaging. So that's one element of the project. Another is on fire management and fire behavior and its effects on these resources. The sum goal is to protect and preserve this nonrenewable record for, you know, as long as we can on these on these really unique and important landscapes.

Bob Keane: Geez, what a wonderful study. So let's get back to this particular paper. Megan, tell us, what did you find? Where are where are the highest impacts of wildfire on these archaeological records?

Megan Friggens: Well, what we did for this analysis is we used machine learning algorithm, and specifically the Random Forest software program, to look at the relationship between observed fire effects on archaeological artifacts and features at the site, as well as the observed fire severity at the site. And relating that to a variety of topographic and climate variables. And so there's essentially two components in this analysis: one, do we observe a fire effect at all? And then the second is: what was observed fire severity out a particular site? And so what we found is that both topography and climate were important predictors of whether we observed either of those types of fire impacts. For the most part, though, we found that climate variables were more important for predicting observed fire impacts within these archaeological sites, and it was more of a combination for a different levels of observed fire severity.

Bob Keane: Oh, okay. So, Rachel, as you know, I've studied fuels for nearly all my career, and I was wondering, of course you didn't include fuels in your Random Forest analysis, but how important do you think fuels are to the protection or the damage to these archaeological resources?

Rachel Loehman: Yeah, so we did include some fuel variables at a very coarse scale relative to the fuels that you study Bob, and that we know are really important in fire effects. So we included fuels as fuel models, so fuel loading models, the Scott and Burgan 40 fuel models, and then some vegetation variables that were meant to reflect both the ecological setting in which these sites occurred, but then also the amount of biomass that surrounded them. But that's not the same as incorporating the individual sticks that essentially contact these resources and cause damage at the artifact level. And so it is really important to incorporate fuels and as fine a method as possible for understanding fire effects for everything—for animals for plants for cultural resources. But we have to weigh that with the sort of the applicability and the generalizability of the model that we were trying to build. Because one of the things that actually an archaeologist just told me on a conversation this morning, when I asked her what one of the most important questions that this type of research could answer is,

is that she told me they need a way to predict where sites are that are at the highest risk of damage. And they have to be able to, there has to be a method for doing that without mapping individual sticks on the ground. So if a tree falls across a site that has a small Pueblo or something on it a dwelling site where that tree burns, as it contacts, potsherds, or stone tools, or the walls of that site, there's going to be an effect and probably a negative a negative effect from that tree burning. But we don't have a good way now because we don't have precise fuel mapping for you know, sort of the individual fuel piece level, although that's coming, we don't have a good way for knowing you know, where those logs are on individual sites. And so what we tried to do is build a model that could be predictive at the landscape scale at which these fuel treatments and restoration treatments are happening. But my last caveat is to say that fuels are always important. I mean, without mapping fuels, understanding fuels, understanding the relationship of fuels, fire behavior, and fire effects, you know, where we are missing some of the story and of course, fuels are what are treated to mitigate these unwanted impacts.

Bob Keane: So, Megan, you found that the highest severity impacts were on the southern slopes that are steep and have less accumulated soil surface moisture. Does that still hold with a really dry year, extreme fire year?

Megan Friggens: Yes, the results show in general that multiple different variables were important, were associated with higher severity burns at a given site. And those variables, whether they were dealing with topography or climate tended to indicate sites with drier conditions were more likely to have high severity fires. And so we felt this is important given that some of the future climate projections are saying that this area is going to get drier. So these types of findings, I think, can be significant for how we think about the risks to archaeological sites going forward in the future. So it wasn't just the particular variables being more important, but often it was the combination of variables and the way these algorithms can work, they're looking at multiple conditions, range of values within all the predictor variables that we use at the same time. And so what we found, from kind of the big picture perspective across these landscapes is those sites that had drier conditions or a tendency to be drier because of their location, we're more likely to have those observed higher burn severity.

Bob Keane: Oh, great, wonderful. Rachel, who's going to use this information from this paper? How do you envision this happening?

Rachel Loehman: I hope it'll be used in a couple of different ways. Number one, on the ground by land managers, and archaeologists. I hope this for one thing gives a common language to fire managers, land managers, and archaeologists. So, you know, for nearly the first time we've created a model and an analytical tool and information that unites those worlds, that allows people who do fuel treatments and who plan for prescribed fire to understand in fire terms, what the impacts are to cultural resources, and what the relationship is of topography, fuels, and weather variables to these unwanted impacts. And so I think, my hope is that this is the beginning of creating that sort of common language and common way of looking at land management that incorporates multiple different types of resources. Second, I hope that archaeologists on the ground I think archaeologists on the ground can use this as a way of triaging sites. Even if we haven't gotten to the level of, you know, mapping and understanding the relationship of individual fuels, fuel pieces, or fuel particles to archaeological fire effects, I think we've provided enough information for archaeologists to start to triage those sites that might be of higher priority for fuels treatments to mitigate these unwanted effects. We've given them some information and coupled with the rest of the ArcBurn project on which types of artifacts that are present that sites are more sensitive to fire effects. And archaeologists who work in fire prone environments know, in general, what types of artifacts are more sensitive and so now we've given them some variables to locate on the landscape, which of their sites they might want to send fuels treatment crews to first or which, you know, they might want to be especially mindful of in a prescribed fire or in the face of a wildfire. And then the third thing that we've done is provided the foundation for future modeling and analysis at that finer scale in terms of our

input variables, and in terms of maybe some dynamic fuels and vegetation variables. So to be able to say, kind of what you alluded to Bob, which is, you know, under these contemporary conditions, we have this certain risk, if we increase fuel aridity by 20%, across the board, you know, how does that change our picture? Or if we remove all coarse woody debris from sites? How does that change our picture? So I think this is, you know, this is really the first project of its kind, and I think it's going to open a lot of doors.

Bob Keane: Oh, I am sure it will be used. What a great paper, both of you and your other coauthors, who were Connie Constan and Rebekah Kneifel. I want to thank them as well. Megan, is there anybody or anything you want to acknowledge before we end this podcast?

Megan Friggens: I guess I do, you know, at the start of this particular analysis, a huge component that I think is easy to, to forget about is that there is this wealth of information in these postfire archaeological assessments and literally 1000s of assessments just for the Jemez Mountains that we were dealing with, but I think all across the country as well. And there's a tremendous amount of work that's put into recording a lot of detail of information on these sites. And I believe that this is one of the first efforts to collate that information into a single database and start to analyze how that information is recorded, but also to use it in these types of models. And that that in and of itself has been a really valuable outcome I think of this analysis, as well as I think something that might be of interest to archaeologists.

Rachel Loehman: Absolutely. And I want to echo what Megan was talking about in terms of the effort that goes into the collection of archaeological data. And just we have this text in the acknowledgement section, but I just want to read it here for everyone. We say “We gratefully acknowledge archaeologists who document, manage, and protect archaeological sites and who provided data for this research.” And that's absolutely true. 1000s and 1000s of person hours by archaeologists to, you know, to collect information to visit these sites to preserve them as best they can. And I want to thank them for their patience. The pace of research doesn't always match the pace of information need, especially when we're talking about topics like climate changes and wildfires. It's my ongoing promise and probably Megan's ongoing promise to these colleagues of ours that we continue to try to provide the best information that we can as fast as we can to protect this valuable legacy that doesn't exist in the same manner anywhere else in the world.

Bob Keane: As I understand it, this was a Joint Fire Science funded program; do you want to tell people where they can find more information about the ArcBurn program?

Rachel Loehman: So the best way for people to learn about the ArcBurn project is to send me an email at rloehman@usgs.gov. You can also read about us by googling ArcBurn which will take you to the FRAMES website. And we also have a link to the project from the Rocky Mountain Research Station website.

Bob Keane: Well, thank you both of you again. I appreciate your time giving it to Fire Ecology Chats and I just like to end by saying this is Bob Keane chatting about fire ecology. Thank you.